



COMPLIANCE COMMITTEE

CC/ERT/ARR/2020/5
10 February 2020

**Report of the individual review of the annual submission of
the United Kingdom of Great Britain and Northern Ireland submitted in
2019**

Note by the secretariat

The report of the individual review of the annual submission of the United Kingdom of Great Britain and Northern Ireland submitted in 2019 was published on 7 February 2020. For purposes of rule 10, paragraph 2, of the rules of procedure of the Compliance Committee (annex to decision 4/CMP.2, as amended by decisions 4/CMP.4 and 8/CMP.9), the report is considered received by the secretariat on the same date. This report, FCCC/ARR/2019/GBR, contained in the annex to this note, is being forwarded to the Compliance Committee in accordance with section VI, paragraph 3, of the annex to decision 27/CMP.1.



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Report on the individual review of the annual submission of the United Kingdom of Great Britain and Northern Ireland submitted in 2019*

Note by the expert review team

Summary

Each Party included in Annex I to the Convention must submit an annual inventory of emissions and removals of greenhouse gases for all years from the base year (or period) to two years before the inventory due date (decision 24/CP.19). Parties included in Annex I to the Convention that are Parties to the Kyoto Protocol are also required to report supplementary information under Article 7, paragraph 1, of the Kyoto Protocol with the inventory submission due under the Convention. This report presents the results of the individual inventory review of the 2019 annual submission of the United Kingdom of Great Britain and Northern Ireland, conducted by an expert review team in accordance with the “Guidelines for review under Article 8 of the Kyoto Protocol”. The review took place from 30 September to 5 October 2019 in London.

* In the symbol for this document, 2019 refers to the year in which the inventory was submitted, not to the year of publication.



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Abbreviations and acronyms

2006 IPCC Guidelines	<i>2006 IPCC Guidelines for National Greenhouse Gas Inventories</i>
AAU	assigned amount unit
AD	activity data
Annex A source	source category included in Annex A to the Kyoto Protocol
AR	afforestation and reforestation
Article 8 review guidelines	“Guidelines for review under Article 8 of the Kyoto Protocol”
BOD	biochemical oxygen demand
C	carbon
CER	certified emission reduction
CH ₄	methane
CM	cropland management
CO ₂	carbon dioxide
CO ₂ eq	carbon dioxide equivalent
COD	chemical oxygen demand
Convention reporting adherence	adherence to the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories”
CP	commitment period of the Kyoto Protocol
CPR	commitment period reserve
CRF	common reporting format
DC	degradable organic component
Defra	Department for Environment, Food and Rural Affairs
DOC	degradable organic carbon
DOC _f	fraction of degradable organic carbon that decomposes
DUKES	Digest of United Kingdom Energy Statistics
EEMS	Environmental Emissions Monitoring System
EF	emission factor
ERT	expert review team
ERU	emission reduction unit
EU ETS	European Union Emissions Trading System
F-gas	fluorinated gas
FGD	flue gas desulfurization
FM	forest management
FMRL	forest management reference level
FOD	first-order decay
Frac _{IND-COM}	fraction of industrial and commercial co-discharged protein into the sewer system
Frac _{NON-CON}	fraction of non-consumed protein added to wastewater
GHG	greenhouse gas
GM	grazing land management
GWP	global warming potential
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
HFO	hydrofluoroolefin
HGV	heavy goods vehicle
HWP	harvested wood products
IE	included elsewhere
IEA	International Energy Agency

IEF	implied emission factor
initial report	report to facilitate the calculation of the assigned amount for the second commitment period of the Kyoto Protocol (2013–2020)
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
KP reporting adherence	adherence to the reporting guidelines under Article 7, paragraph 1, of the Kyoto Protocol
KP-LULUCF activities	activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
Kyoto Protocol Supplement	<i>2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol</i>
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
MCF	methane correction factor
MMS	manure management system(s)
N	nitrogen
N ₂ O	nitrous oxide
NA	not applicable
NE	not estimated
NF ₃	nitrogen trifluoride
NFI	national forest inventory
NIR	national inventory report
NO	not occurring
OECD	Organisation for Economic Co-operation and Development
PFC	perfluorocarbon
QA/QC	quality assurance/quality control
RMU	removal unit
RV	revegetation
SEF	standard electronic format
SF ₆	sulfur hexafluoride
SOC	soil organic carbon
UNFCCC Annex I inventory reporting guidelines	“Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories”
UNFCCC review guidelines	“Guidelines for the technical review of information reported under the Convention related to greenhouse gas inventories, biennial reports and national communications by Parties included in Annex I to the Convention”
WDR	wetland drainage and rewetting
Wetlands Supplement	<i>2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands</i>

I. Introduction¹

1. This report covers the review of the 2019 annual submission of the United Kingdom of Great Britain and Northern Ireland organized by the secretariat in accordance with the Article 8 review guidelines (adopted by decision 22/CMP.1 and revised by decision 4/CMP.11). In accordance with the Article 8 review guidelines, this review process also encompasses the review under the Convention as described in the UNFCCC review guidelines, particularly in part III thereof, namely the “UNFCCC guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention” (decision 13/CP.20). The review took place from 30 September to 5 October 2019 in London and was coordinated by Lisa Hanle and Nashib Kafle (secretariat). Table 1 provides information on the composition of the ERT that conducted the review of the United Kingdom.

Table 1

Composition of the expert review team that conducted the review of the United Kingdom of Great Britain and Northern Ireland

<i>Area of expertise</i>	<i>Name</i>	<i>Party</i>
Generalist	Daniela Romano	Italy
Energy	Frank Neitzert	Canada
IPPU	Roman Kazakov	Russian Federation
Agriculture	Paulo Cornejo	Chile
LULUCF and KP-LULUCF activities	Thelma Krug	Brazil
Waste	Chart Chiemchaisri	Thailand
Lead reviewers	Paulo Cornejo	
	Daniela Romano	

2. The basis of the findings in this report is the assessment by the ERT of the Party’s 2019 annual submission in accordance with the UNFCCC review guidelines and the Article 8 review guidelines. The ERT notes that the individual inventory review of the United Kingdom’s 2018 annual submission did not take place in 2018 owing to insufficient funding for the review process.

3. The ERT has made recommendations that the United Kingdom resolve the findings related to issues,² including issues designated as problems.³ Other findings, and, if applicable, the encouragements of the ERT to the United Kingdom to resolve them, are also included.

4. A draft version of this report was communicated to the Government of the United Kingdom, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

5. Annex I shows annual GHG emissions for the United Kingdom, including totals excluding and including the LULUCF sector, indirect CO₂ emissions, and emissions by gas and by sector. Annex I also contains background data related to emissions and removals from KP-LULUCF activities, if elected by the United Kingdom, by gas, sector and activity.

6. Information to be included in the compilation and accounting database can be found in annex II.

¹ At the time of publication of this report, the United Kingdom of Great Britain and Northern Ireland had submitted its instrument of ratification of the Doha Amendment; however, the Amendment had not yet entered into force. The implementation of the provisions of the Doha Amendment is therefore considered in this report in the context of decision 1/CMP.8, para. 6, pending the entry into force of the Amendment.

² Issues are defined in decision 13/CP.20, annex, para. 81.

³ Problems are defined in decision 22/CMP.1, annex, paras. 68–69, as revised by decision 4/CMP.11.

II. Summary and general assessment of the 2019 annual submission

7. Table 2 provides the assessment by the ERT of the annual submission with respect to the tasks undertaken during the review. Further information on the issues identified, as well as additional findings, may be found in tables 3 and 5.

Table 2

Summary of review results and general assessment of the inventory of the United Kingdom of Great Britain and Northern Ireland

Assessment		Issue or problem ID#(s) in table 3 and/or 5 ^a	
Date of submission	Original submission: 15 April 2019 (NIR), 15 April 2019 (CRF tables) version 2, 15 April 2019 (SEF-CP2-2018)		
Review format	In-country		
Application of the requirements of the UNFCCC Annex I inventory reporting guidelines and Wetlands Supplement (if applicable)	Have any issues been identified in the following areas:		
	(a) Identification of key categories?	Yes	G.9, L.5
	(b) Selection and use of methodologies and assumptions?	Yes	I.22, I.31, W.12, W.14, KL.7
	(c) Development and selection of EFs?	Yes	A.12, L.20
	(d) Collection and selection of AD?	Yes	E.18, E.25, I.13, A.13, L.13, L.36, W.13, W.18
	(e) Reporting of recalculations?	No	
	(f) Reporting of a consistent time series?	Yes	I.21, L.15
	(g) Reporting of uncertainties, including methodologies?	Yes	G.12, G.13, A.10
	(h) QA/QC?	QA/QC procedures were assessed in the context of the national system (see supplementary information under the Kyoto Protocol below)	
	(i) Missing categories/completeness? ^b	Yes	E.21, I.2, I.19, I.20, I.28, A.1, L.6, L.14, L.25, L.27, L.28, KL.4, KL.9, KL.13, KL.19, KL.20
	(j) Application of corrections to the inventory?	No	
Significance threshold	For categories reported as insignificant, has the Party provided sufficient information showing that the likely level of emissions meets the criteria in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines?	No	G.11, I.6
Description of trends	Did the ERT conclude that the description in the NIR of the trends for the different gases and sectors is reasonable?	Yes	
Supplementary information under the Kyoto Protocol	Have any issues been identified related to the following aspects of the national system:		
	(a) Overall organization of the national system, including the effectiveness and reliability of the institutional, procedural and legal arrangements?	No	
	(b) Performance of the national system functions?	Yes	G.5
	Have any issues been identified related to the national registry:		
	(a) Overall functioning of the national registry?	No	

<i>Assessment</i>		<i>Issue or problem ID#(s) in table 3 and/or 5^a</i>	
	(b) Performance of the functions of the national registry and the technical standards for data exchange?	No	
	Have any issues been identified related to reporting of information on AAUs, CERs, ERUs and RMUs and on discrepancies reported in accordance with decision 15/CMP.1, annex, chapter I.E, in conjunction with decision 3/CMP.11, taking into consideration any findings or recommendations contained in the standard independent assessment report?	No	
	Have any issues been identified in matters related to Article 3, paragraph 14, of the Kyoto Protocol, specifically problems related to the transparency, completeness or timeliness of reporting on the Party's activities related to the priority actions listed in decision 15/CMP.1, annex, paragraph 24, in conjunction with decision 3/CMP.11, including any changes since the previous annual submission?	No	
	Have any issues been identified related to the following reporting requirements for KP-LULUCF activities:		
	(a) Reporting requirements of decision 2/CMP.8, annex II, paragraphs 1–5?	Yes	KL.20, KL.23
	(b) Demonstration of methodological consistency between the reference level and reporting on FM in accordance with decision 2/CMP.7, annex, paragraph 14?	No	
	(c) Reporting requirements of decision 6/CMP.9?	Yes	KL.10, KL.11, KL.17
	(d) Country-specific information to support provisions for natural disturbances, in accordance with decision 2/CMP.7, annex, paragraphs 33 and 34?	Yes	KL.15
CPR	Was the CPR reported in accordance with the annex to decision 18/CP.7, the annex to decision 11/CMP.1 and decision 1/CMP.8, paragraph 18?	No	G.2
Adjustments	Has the ERT applied an adjustment under Article 5, paragraph 2, of the Kyoto Protocol?	No	
	Did the Party submit a revised estimate to replace a previously applied adjustment?	NA	The United Kingdom does not have a previously applied adjustment
Response from the Party during the review	Has the Party provided the ERT with responses to the questions raised, including the data and information necessary for the assessment of conformity with the UNFCCC Annex I inventory reporting guidelines and any further guidance adopted by the Conference of the Parties?	Yes	
Recommendation for an exceptional in-country review	On the basis of the issues identified, does the ERT recommend that the next review be conducted as an in-country review?	No	
Questions of implementation	Did the ERT list any questions of implementation?	No	

^a The ERT identified additional issues and/or problems in all sectors as well as issues and/or problems related to reporting on KP-LULUCF activities that are not listed in this table but are included in table 5.

^b Missing categories for which methods are provided in the 2006 IPCC Guidelines may affect completeness and are listed in annex III.

III. Status of implementation of issues and/or problems raised in the previous review report

8. Table 3 compiles all the recommendations made in previous review reports that were included in the previous review report, published on 8 March 2018.⁴ For each issue and/or problem, the ERT specified whether it believes the issue and/or problem has been resolved by the conclusion of the review of the 2019 annual submission and provided the rationale for its determination, which takes into consideration the publication date of the previous review report and national circumstances.

Table 3

Status of implementation of issues and/or problems raised in the previous review report of the United Kingdom of Great Britain and Northern Ireland

<i>ID#</i>	<i>Issue and/or problem classification^{a, b}</i>	<i>Recommendation made in previous review report</i>	<i>ERT assessment and rationale</i>
General			
G.1	Annual submission (G.1, 2017) (G.3, 2016) (G.3, 2015) (15, 2014) Transparency	Improve the transparency of the NIR by including sufficient information in the annual submission.	Addressing. The ERT notes that there were two outstanding recommendations related to this issue in the previous review report, only one of which has been resolved. The United Kingdom provided in the NIR additional information on AD related to the management of forests, including privately owned forests (see ID# L.9 below). The Party also described in its NIR the methodology and parameters used for estimating and reporting emissions from solid waste disposal sites in the overseas territories and Crown dependencies (annexes, p.770) but the actual AD and EF used for estimating these emissions are not included in the totals reported in CRF table 5.A (see ID# W.1 below).
G.2	CPR (G.7, 2017) (G.11, 2016) (G.11, 2015) KP reporting adherence	When preparing the NIR, compare the 90 per cent of assigned amount value against the total GHG emissions, excluding LULUCF, in the most recent year.	Not resolved. The United Kingdom reported a CPR of 2,471,658,632 t CO ₂ eq (NIR, p.500). The ERT determined this value to be incorrect because the Party did not use the correct assigned amount or the most recently reviewed inventory in its calculations. The assigned amount reported in the NIR (2,746,287,369 AAUs) (p.500) does not match that in the United Kingdom's initial report (2,744,937,332 t CO ₂ eq). Ninety per cent of the assigned amount would equal 2,470,443,599 t CO ₂ eq. In addition, the Party calculated the CPR using the total emissions, excluding LULUCF, reported in its 2018 submission under the Convention. However, the value to be compared with is eight times the most recently reviewed inventory under the Kyoto Protocol (i.e. $8 \times 473,569,767 = 3,788,558,138$ t CO ₂ eq). The correct value for the CPR is 2,470,443,599 t CO ₂ eq. During the review, the Party agreed with this value.

⁴ FCCC/ARR/2017/GBR. The ERT notes that the report on the individual inventory review of the United Kingdom's 2018 annual submission has not been published yet. As a result, the latest previously published annual review report reflects the findings of the review of the Party's 2017 annual submission.

<i>ID#</i>	<i>Issue and/or problem classification^{a, b}</i>	<i>Recommendation made in previous review report</i>	<i>ERT assessment and rationale</i>
G.3	Key category analysis (G.2, 2017) (G.8, 2016) (G.8, 2015) Transparency	Provide justification for the level of category disaggregation used and the rationale for its use if there is any deviation from the level suggested by the 2006 IPCC Guidelines.	Resolved. The United Kingdom provided a justification for the level of category disaggregation used in its key category analysis and explanations of deviations from the level presented in the 2006 IPCC Guidelines, with specific clarifications for the LULUCF and agriculture sectors (NIR, annexes, pp.573–616).
G.4	Methods (G.3, 2017) (G.7, 2016) (G.7, 2015) Transparency	Address the transparency issues identified in the previous review reports.	Addressing. The ERT notes that there were two outstanding recommendations related to this issue in the previous review report (issue ID#s L.1 and W.1 below, as noted also in ID# G.1 above). Although the United Kingdom improved the description of methods in the NIR for the issues identified in the previous review report, detailed information on the estimation of emissions from solid waste disposal sites in the overseas territories and Crown dependencies is still required (see ID# W.1 below).
G.5	National system (G.8, 2017) (G.13, 2016) (G.13, 2015) Completeness	Strengthen the national system in order to ensure the completeness of the coverage of the LULUCF and KP-LULUCF estimates of emissions and removals, and report on improvements made in the NIR.	Addressing. Further work is needed to strengthen the national system in order to ensure the completeness of coverage of the LULUCF emission/removal estimates and the identification of CM, GM and WDR lands for the KP-LULUCF estimates. The United Kingdom provided information on its efforts to improve institutional networks in the Cayman Islands and Bermuda so as to enable access to data, which resulted in progress in the completeness of estimates for these overseas territories (NIR, p.459).
G.6	Recalculations (G.10, 2017) Transparency	Continue to improve the transparency of reporting by providing explanations of recalculations in the NIR in accordance with paragraph 44 of the UNFCCC Annex I inventory reporting guidelines.	Resolved. The ERT reviewed the explanations of recalculations in the NIR and concludes that the discussion of recalculations in the NIR is sufficient and consistent with the UNFCCC Annex I inventory reporting guidelines (NIR, pp.412–434 and the category-level discussions in the individual chapters).
G.7	Recalculations (G.10, 2017) Transparency	Improve the consistency of the reporting of recalculations between the NIR and CRF tables, providing in the NIR the explanations for differences therein shared with the ERT during the review (i.e. the differences in recalculations owing to different territorial coverage under the Convention and the Kyoto Protocol).	Resolved. The differences in inventory data arising from changes in territorial coverage were an issue specific to the 2017 annual submission.
G.8	Uncertainty analysis (G.5, 2017) (G.9, 2016) (G.9, 2015) Transparency	Include in the NIR a brief description of and reference to the information used to quantitatively assess the uncertainty for all categories where expert judgment was used.	Resolved. The United Kingdom provided justifications for the parameters used in the uncertainty analysis in NIR tables A 2.3.1–2.3.4. The Party also provided documentation for those parameters that have a significant impact on the key category analysis, including for categories for which expert judgment was used. The ERT considers this information adequate for the transparency of the uncertainty figures used in the uncertainty assessment.

<i>ID#</i>	<i>Issue and/or problem classification^{a, b}</i>	<i>Recommendation made in previous review report</i>	<i>ERT assessment and rationale</i>
Energy			
E.1	1. General (energy sector) – all fuels – CO ₂ , CH ₄ and N ₂ O (E.1, 2017) (E.20, 2016) (E.20, 2015) Transparency	Clearly indicate the geographical coverage of DUKES and demonstrate how fuel consumption data at the subcategory level for each overseas territory and Crown dependency are obtained and incorporated into the national totals for that subcategory.	Addressing. The United Kingdom clarified the DUKES coverage and the provision of AD from overseas territories and Crown dependencies in the NIR. Specifically, annexes (pp.781 and 788) describe how fuel consumption data at the sectoral level are obtained and incorporated into the national totals, clarifying that DUKES covers the United Kingdom and its Crown dependencies. Fuel use estimates for the overseas territories are not included in DUKES; they are obtained by direct communication. However, there is no information in the NIR on the procedures for obtaining fuel consumption data at the subcategory level from the overseas territories and Crown dependencies and incorporating those data into the GHG inventory.
E.2	1. General (energy sector) – liquid and gaseous fuels – CO ₂ , CH ₄ and N ₂ O (E.2, 2017) (E.21, 2016) (E.21, 2015) Accuracy	Rectify the stock data in the energy statistics and implement relevant recalculations in the CRF tables, as necessary, and explain all the recalculations in the NIR.	Resolved. The United Kingdom analysed the stock data for the 2018 annual submission, reporting in the 2018 NIR that in its view the difference in stock data is simply the result of differences in the way DUKES and IEA account for stock data related to “international tickets” (related to “reserved” or “set aside” exports and imports) in some years (p.434). The Party indicated that it did not have plans to modify the energy statistics in DUKES. In fact, a more recent comparative report from IEA indicates that while total liquid fuel stocks show an average difference of 58.8 per cent from 1990 to 2016 when compared with IEA data, the difference is only 6.2 per cent in 2017. For gaseous fuels, the corresponding average difference is 22.1 per cent from 1990 to 2016, while in 2017 the difference is 0 per cent. Although these reduced numerical differences may not hold for all future years, the ERT accepts the United Kingdom’s explanation that the apparent accounting difference between the two data sets is not indicative of a fault in the Party’s national energy balance. The ERT did not identify any issues with the explanation of recalculations in the 2019 annual submission.
E.3	Feedstocks, reductants and other non-energy use of fuels – liquid fuels – CO ₂ (E.13, 2017) Comparability	Ensure reporting is complete as well as consistent between CRF tables 1.A(b) and 1.A(d) by reporting data or notation keys for other gaseous fuels in CRF table 1.A(b) and by using the same data or notation keys for other liquid fossil fuels, other gaseous fuels, and other fossil fuels in CRF table 1.A(b) in the corresponding cells in CRF table 1.A(d).	Addressing. The United Kingdom reported the notation key “NO” for other gaseous fuels in CRF table 1.A(b), but continues to report blank cells for other liquid fossil fuels, other gaseous fuels and other fossil fuels in CRF table 1.A(d). The Party noted in the NIR (p.127) that it was not possible to enter “NO”, as intended, for other liquid fossil fuels, other gaseous fuels and other fossil fuels in CRF table 1.A(d). However, the ERT notes that this issue can be resolved in the CRF table by specifying the notation key “NO” for these fuels in CRF

ID#	Issue and/or problem classification ^{a, b}	Recommendation made in previous review report	ERT assessment and rationale
			Reporter without creating subcategories for them.
E.4	International navigation – liquid fuels – CO ₂ , CH ₄ and N ₂ O (E.5, 2017) (E.24, 2016) (E.24, 2015) Accuracy	Ensure the accuracy of the emission estimates for international navigation bunkers as well as the internal consistency between CRF tables 1.D and 1.A(b) by using the correct calorific values to convert activity from a mass basis to an energy basis.	Resolved. The United Kingdom investigated this issue further, and states in the NIR that the remaining differences between the data reported in CRF tables 1.D and 1.A(b) are primarily due to independent, simplified and weighted calorific values being used in the reference approach while category-specific calorific values are used in the sectoral approach (p.460). According to the United Kingdom, the accuracy of the emission estimates has been ensured. The ERT agrees with the Party's assessment.
E.5	1.A.1.c Manufacture of solid fuels and other energy industries – liquid fuels – CO ₂ , CH ₄ and N ₂ O (E.6, 2017) (E.25, 2016) (E.25, 2015) Transparency	Provide a clear and concise explanation that the estimates for AD and for CO ₂ , CH ₄ and N ₂ O emissions from subcategory 1.A.1.c.ii (oil and gas extraction) are complete, including relevant information (i.e. that the gap in data reporting applies to onshore terminals only and that the data from the EU ETS are very closely consistent with other reporting of emissions from the same installations under parallel regulatory mechanisms).	Resolved. In the NIR, the Party states in reference to subcategory 1.A.1.c.ii (oil and gas extraction) that “the United Kingdom inventory is complete for all emission sources” (p.138). It also confirmed that, though there are gaps in DUKES data, including for onshore terminals, these are filled by data from the EU ETS. The United Kingdom provided a detailed description of how comparisons among EEMS, the EU ETS and DUKES are used for QA/QC and how time-series consistency is maintained by interpolation using a number of sources (NIR, pp.139–140).
E.6	1.A.1.c Manufacture of solid fuels and other energy industries – liquid fuels – CO ₂ , CH ₄ and N ₂ O (E.7, 2017) (E.25, 2016) (E.25, 2015) Accuracy	Provide in the NIR up-to-date information on the consideration of, or progress made in, efforts to improve the energy statistics collection system for LPG and other petroleum gas fuels abstracted from upstream oil and gas exploration and production sources.	Resolved. The United Kingdom reported that amendments have been made in the DUKES system for LPG and other petroleum gas fuels on the basis of reported EEMS and EU ETS data, which were communicated by the inventory team to the DUKES team working at the Department for Business, Energy and Industrial Strategy (NIR, pp.137–138). During the review, the Party showed the ERT some examples of typical gaps in the energy statistics that it was able to fill through an analysis of the detailed facility data it receives from its energy regulators. Further information is provided in the NIR, where the Party explains in a transparent manner how these data are used to form a consistent time series of energy data for upstream oil and gas exploration and production (p.138). The ERT commends the United Kingdom for its efforts to resolve this issue.
E.7	1.A.1.c Manufacture of solid fuels and other energy industries – liquid fuels – N ₂ O (E.15, 2017) Transparency	Justify in the NIR the application of high N ₂ O EFs (e.g. that they are informed by operator-reported data and are dominated by offshore combustion of natural gas).	Resolved. The United Kingdom reported that the relatively high N ₂ O EFs applied in its inventory are based on operator-reported data from predominantly offshore oil and gas facilities using fuel gas, which is mainly natural gas or gas associated with oil production (NIR, p.138).
E.8	1.A.2.b Non-ferrous metals – solid fuels –	Investigate the underlying cause of the drop in the CO ₂ EF for coal use	Resolved. The United Kingdom updated its CO ₂ EF for coal use by autogenerators in non-

<i>ID#</i>	<i>Issue and/or problem classification^{a, b}</i>	<i>Recommendation made in previous review report</i>	<i>ERT assessment and rationale</i>
	CO ₂ (E.9, 2017) (E.27, 2016) (E.27, 2015) Transparency	in the Lynemouth aluminium smelter between 2003 and 2005 and report the findings of this investigation in the NIR.	ferrous metal production (1.A.2.b) (NIR, p.142). Data reported by the Lynemouth aluminium smelter comprise the primary determinant of the EF for these autogenerators. In previous annual submissions, the EF from 1990 to 2004 was based on country-specific information (Baggott et al., 2004), while the EF for 2005 onward was derived from EU ETS data, which are dominated by data from the Lynemouth smelter. The use of different data sources resulted in the observed reduction in the CO ₂ EF between 2003 and 2005. The mass-based CO ₂ EF for coal used in non-ferrous metal production for 1990 to 2004 is now the average of 2005 to 2007 from EU ETS-reported data. From 2005 to 2011, the EF is based on annual EU ETS data, so it varies slightly but is nevertheless reasonably consistent with the earlier years. During the review, the United Kingdom explained that the Lynemouth aluminium smelter closed in 2012, so to avoid further step changes from 2012 onward, the non-ferrous metal CO ₂ EF is held constant at a value based on the last EU ETS data reported before the smelter closed. The ERT considers that the findings explain the reason for the previous step change and the update, which eliminates the drop in the CO ₂ EF for coal use between 2003 and 2005, is reasonable.
E.9	1.A.2.b Non-ferrous metals – solid fuels – CH ₄ (E.16, 2017) Transparency	Describe in the NIR the fluctuation in the CH ₄ IEF over the time series, especially between 2012 and 2015.	Resolved. The United Kingdom continues to report large inter-annual changes in the CH ₄ IEF for solid fuels between 2012 (1.31 kg CH ₄ /TJ) and 2015 (6.97 kg CH ₄ /TJ). The Party satisfactorily explained how this trend was caused by the closure of an aluminium plant with an on-site cogeneration system and the subsequent reallocation of that electricity generator to subcategory 1.A.1 (energy industries) from 2013 onward (NIR, p.143).
E.10	1.A.3.a Domestic aviation – liquid fuels – CH ₄ (E.17, 2017) Transparency	Describe in detail in the NIR any changes in assumptions for the CH ₄ EF for aviation fuel to justify the unique trend in the IEF between 2009 and 2010.	Resolved. The ERT notes that this category has been recalculated since the 2017 annual submission, and the inter-annual change in the CH ₄ IEF is now smaller. In the 2019 submission, the IEF increased by 8.6 per cent between 2009 (53.45 kg CH ₄ /TJ) and 2010 (58.07 kg CH ₄ /TJ), while there was a decrease between these years of 49.5 per cent in the 2017 annual submission. Text has been added to the NIR explaining that consistent data sets and methodologies have been used throughout the time series (p.161). Furthermore, the NIR indicates that the unique trend in the CH ₄ IEF is the result of significant variations in CH ₄ emissions from different aircraft burning aviation gasoline, and as the overall use of this fuel in aviation is low, the IEF can vary considerably. This variation is particularly apparent between 2009 and 2010.

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E.11	1.A.4.a Commercial/institutional – biomass – CH ₄ (E.18, 2017) Transparency	Ensure that the notation key “NO” is used for biomass combustion in CRF table 1.A(a)s4, and that a brief mention in the corresponding method statement in the NIR is made about this source not occurring.	Addressing. The Party states that biomass combustion under this category is not occurring in the United Kingdom (NIR, p.151). However, the notation key “NO” was not used for biomass combustion in CRF table 1.A(a)s4 and the Party noted that it was not possible to enter “NO” for biomass combustion under category 1.A.4.a (NIR, p.151). However, the ERT notes that this issue can be resolved by adding biomass as a fuel type under the node 1.A.4.a.i (stationary combustion) and using the notation key “NO” for this fuel in CRF table 1.A(a)s4.
E.12	1.B Fugitive emissions from fuels – all fuels – CO ₂ , CH ₄ and N ₂ O (E.20, 2017) Transparency	Where possible, include all subcategory EFs for CO ₂ , CH ₄ and N ₂ O and corresponding references for their sources for category 1.B (fugitive emissions from fuels) in the NIR or the accompanying background data file.	Resolved. The ERT confirms that all EFs, including those for category 1.B, were included in the background data spreadsheet accompanying the NIR. The ERT commends the United Kingdom for providing this very useful documentation.
E.13	1.B Fugitive emissions from fuels – all fuels – CO ₂ , CH ₄ and N ₂ O (E.20, 2017) Transparency	For all subcategories where emissions are directly reported and EFs cannot be reported, provide information in the NIR to clarify how the estimates are compiled from operator-reported data.	Resolved. The United Kingdom added text to the relevant method statements to clarify the inventory method for the subcategories where emissions are directly reported and EFs cannot be reported (NIR, p.440). The Party clearly explained how it used directly reported, quality-controlled facility emission data in its estimates, and outlined how installation data are compared between reporting systems and how operator-reported estimates are aggregated and utilized as AD and emission data (NIR, pp.199–205).
E.14	1.B.1 Solid fuels – CH ₄ (E.21, 2017) Transparency	Elaborate on the method description in the NIR to explain that the estimates are complete and that, although EF data are not available for 2015, the EFs for 2013 and 2014 were applied to the complete and consistent AD time series of coal production.	Resolved. The United Kingdom described which CH ₄ EFs are used, how they are obtained and how they are applied across the entire time series (NIR, pp.193–194). The description includes details on how time-series consistency and completeness is maintained in the EFs and the AD.
E.15	1.B.2 Oil and natural gas and other – all fuels – CO ₂ , CH ₄ and CH ₄ (E.24, 2017) Transparency	Describe in more detail the QC measures in place to verify the completeness of onshore exploration and production given the incomplete (voluntary) nature of EEMS and EU ETS data.	Resolved. In the 2017 NIR, the United Kingdom described, in a detailed manner, how facility-reported AD and emission data from many sources are used to provide complete coverage over the time series (taking into consideration that some reporting by operators of onshore terminals is voluntary). The QA/QC measures in place to ensure (among other objectives) completeness and time-series consistency were included in the description (pp.200–205). During the review of the 2019 submission, the Party confirmed that there is no onshore production of oil and natural gas in the country (onshore exploration is considered in ID# E.21 in table 5).
E.16	1.B.2 Oil and natural gas and other – all	Include all IPCC subcategories in NIR table 3.5 as they are reported	Addressing. The United Kingdom provided in NIR table 3.5 explanations for all subcategories

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	fuels – CO ₂ , CH ₄ and N ₂ O (E.25, 2017) Transparency	in CRF table 1.B.2 (e.g. if a subcategory is reported as “IE” in CRF table 1.B.2, include the respective IPCC category in the appropriate row of NIR table 3.5 where the emissions are reported).	reported as “IE” in CRF table 1.B.2 except for 1.B.2.c.1.iii (venting, combined) and 1.B.2.c.2.iii (flaring, combined). Although CRF table 9 indicates that these emissions are allocated to either oil or gas venting or flaring, this information is not included in method statement 18 (NIR, p.198) or in NIR table 3.5.
E.17	1.B.2 Oil and natural gas and other – all fuels – CO ₂ , CH ₄ and N ₂ O (E.25, 2017) Transparency	Review all fugitive emissions from oil and natural gas that are reported as “IE” in the NIR but which the Party has not been able to disaggregate in the CRF tables owing to aggregation levels (i.e. subcategories under natural gas exploration are reported in the NIR) or not transparent in the NIR and report the findings in the NIR.	Resolved. The United Kingdom undertook the recommended review of fugitive emissions and, as noted in NIR table 10.16, information was added to method statement 18 to explain the source data from EEMS and the limited data resolution for the different fugitive emission sources (NIR, pp.198–199). The ERT concludes that the level of detail on this issue in the NIR is sufficient.
E.18	1.B.2 Oil and natural gas and other – all fuels – CO ₂ and CH ₄ (E.27, 2017) Accuracy	Describe in the NIR the coverage of the AD, methods and EFs for estimating emissions from well drilling, well testing and well completions in oil and natural gas exploration, and clarify whether these emissions are reported under category 1.A (fuel combustion activities) or 1.B (fugitive emissions from fuels).	Addressing. The United Kingdom explained in the NIR that it does not separately report emissions from well drilling, completions and testing by its oil and gas facilities (p.203) and that it includes the CO ₂ and CH ₄ emissions from these activities under category 1.B.2 (p.441). The Party did not report transparently the AD, EFs and methods used for estimating these emissions. During the review, the United Kingdom explained that it is developing a facility-based EF to be used to extrapolate emissions for all facilities and that the current approach is conservative, therefore the Party determined it is likely that exploration emissions are covered by what is reported as ‘testing’ and included under category 1.B (fugitive emissions from fuels). The Party states in the NIR that drilling and completion emissions from offshore production are likely to be very small, as any emissions are released at the seabed and dissolved in the water column (p.203). The ERT agrees that emissions are likely to be small and in all cases would be below the level of significance set out in decision 24/CP.19, annex, paragraph 37(b) (237 kt CO ₂ eq in 2017), and therefore below the level of significance for including this issue in the list of potential problems and further questions raised by the ERT in accordance with decision 22/CMP.1 in conjunction with decision 4/CMP.11, annex, paragraph 80(b).
E.19	1.B.2.a Oil – liquid and gaseous fuels – CO ₂ (E.28, 2017) Transparency	Include in NIR table 3.17, under the methodological description for subcategory 1.B.2.c (flaring at upstream oil and gas facilities), the information that CO ₂ emissions from refinery flaring are reported as “IE” and are included under combustion-related emissions from petroleum refining (1.A.1.b).	Resolved. According to NIR table 3.16 (formerly table 3.17), and as further confirmed by the Party during the review, all flaring emissions from refineries are reported in aggregate with stationary combustion emissions under subcategory 1.A.1.b (petroleum refining).

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E.20	1.B.2.a Oil – liquid and gaseous fuels – CO ₂ (E.28, 2017) Transparency	Clearly note in the NIR under method statement 1 (power stations, refineries and other energy industries (p.125)) – 1.A.1.b (petroleum refining) that fugitive CO ₂ emissions from 1.B.2.a.4 (oil refining/storage) are reported with the corresponding combustion emissions from refining.	Resolved. According to method statement 1 (NIR, p.131), fugitive CO ₂ emissions from category 1.B.2.a.4 (oil refining/storage) are reported under stationary combustion in subcategory 1.A.1.b (petroleum refining).
E.21	1.B.2.b Natural gas – gaseous fuels – CO ₂ and CH ₄ (E.29, 2017) Completeness	Estimate and report CO ₂ and CH ₄ emissions from exploratory activities or, if they are considered insignificant, report them as “NE” and justify that the likely level of emissions is below the significance threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Addressing. According to method statement 18 (NIR, p.200), exploratory activities to prepare and drill shale gas test sites are not included in the inventory estimates (although there has been no production, there have been eight well completions at exploratory sites since 2010). The ERT appreciates the calculation made by the United Kingdom that demonstrates that emissions from these new sites would be well below the threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines (the Party noted that to exceed the threshold these exploratory wells would require 4,000 million m ³ of gas to be produced annually) (NIR, p.202). However, the ERT notes that the significance threshold is to be applied at the level of the category (i.e. 1.B.2.b.1 (exploration (natural gas))), and as CO ₂ and CH ₄ emissions are already reported for this category owing to other activities in the United Kingdom, the significance threshold cannot be applied. The ERT also notes that the omitted emissions are below the level of significance for including this issue in the list of potential problems and further questions raised by the ERT in accordance with decision 22/CMP.1 in conjunction with decision 4/CMP.11, annex, paragraph 80(b).
IPPU			
I.1	2.A.2 Lime production – CO ₂ (I.14, 2017) Convention reporting adherence	Collect lime production data so that they may be made available upon request to future ERTs in order to enable them to assess the accuracy, comparability and completeness of the emissions reported under this subcategory in accordance with the UNFCCC review guidelines.	Not resolved. The United Kingdom was not able to collect complete and consistent lime production data, and noted that it does not consider their collection a priority given the completeness and accuracy of the EU ETS data (NIR, pp.220–221). The Party still uses the back-calculation method for determining AD. The ERT notes that this approach does not allow for assessing the accuracy, comparability and completeness of the emissions reported under category 2.A.2 as recommended in the previous review. During the review, the United Kingdom clarified that there is no possibility to collect AD on lime production for the whole inventory period. The ERT noted this limitation on AD sources. However, the Party stated that AD on lime production and/or limestone and dolomite consumption for lime production can be derived from EU ETS reports for 2008 onwards. The ERT agrees with the Party on the

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			proposed approach for validation of emissions based on AD collected from EU ETS reports. The ERT considers that including in the NIR actual AD and corresponding IEFs for 2008 onwards gathered from EU ETS reports instead of using the back-calculation method for AD and IEF estimations would resolve this issue.
I.2	2.A.4 Other process uses of carbonates – CO ₂ (I.15, 2017) Completeness	Either estimate and include in the inventory the CO ₂ emissions associated with the non-glass use of soda ash or include in the NIR a justification, consistent with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines, for these emissions being considered insignificant.	Addressing. The United Kingdom reported emissions from category 2.A.4.b (other uses of soda ash) as “NO”. However, during the review, the ERT noted that the Party has commissioned research on the non-glass use of soda ash and made preliminary estimates. The ERT reviewed the current status of this research with the Party. Based on the Party’s assessment, the expected level of CO ₂ emissions from soda ash use for non-glass applications does not exceed 50 kt CO ₂ eq per year, which is below the threshold of significance given in paragraph 37(b) of the annex to decision 24/CP.19 (for the United Kingdom 237 kt CO ₂ eq in 2017) and therefore below the level of significance for including this issue in the list of potential problems and further questions raised by the ERT in accordance with decision 22/CMP.1 in conjunction with decision 4/CMP.11, annex, paragraph 80(b). The Party states in NIR table 10.1 that CO ₂ emissions resulting from non-glass soda ash use will be reported in the 2020 submission.
I.3	2.B.2 Nitric acid production – N ₂ O (I.16, 2017) Transparency	Include information in the NIR on the abatement systems (e.g. information on efficiency, abatement technology, EF of the unabated process) of the nitric acid production plants that were in operation in the country during the years 2012 to 2015 that justifies the low IEFs.	Resolved. The United Kingdom provided the recommended information on the abatement systems used by nitric acid production plants in the NIR (pp.234–235). During the review, the ERT reviewed the N ₂ O emissions from nitric acid production by analysing EU ETS reports of chemical plants producing nitric acid in the United Kingdom. The ERT agrees that the IEFs for nitric acid production are reasonable.
I.4	2.B.2 Nitric acid production – N ₂ O (I.17, 2017) Adherence to the UNFCCC Annex I inventory reporting guidelines	Update the uncertainty analysis to reflect that N ₂ O emissions from nitric acid production are based on continuous monitoring.	Resolved. The United Kingdom revised the uncertainty analysis and reported it correctly in the NIR (table A.2.1.1). The reported uncertainty value (10 per cent) corresponds to the expected level of uncertainty for continuous monitoring systems used for determining emissions.
I.5	2.C.1 Iron and steel production – CO ₂ (I.18, 2017) Transparency	Update figure 3.1 in the NIR to clarify the subcategories under which CO ₂ emissions from sintering, blast furnaces and oxygen furnaces are reported.	Resolved. The United Kingdom updated figure 3.1 of the NIR to reflect that CO ₂ emissions from sinter production are reported under subcategory 2.C.1.d (sinter), CO ₂ emissions from pig iron production in blast furnaces under subcategory 2.C.1.b (pig iron), and CO ₂ emissions from steel production in oxygen furnaces under subcategory 2.C.1.a (steel).
I.6	2.C.4 Magnesium production – HFCs and PFCs	Either estimate and include in the submission emissions of PFCs and/or HFCs that are the decomposition products from the	Addressing. FK 5-1-12 was not listed as a gas consumed in category 2.C.4 in CRF table 2(II)B-Hs1. The United Kingdom estimated PFC emissions from the decomposition of FK

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	(I.19, 2017) Transparency	use of FK 5-1-12 and HFC-134a by magnesium dye casters or include in the next NIR the information presented to the ERT during the review that justifies, in accordance with the UNFCCC Annex I inventory reporting guidelines, these emissions being considered insignificant.	5-1-12 used in magnesium dye casters, and in its assessment, these emissions comprise less than 0.001 per cent of total national emissions and their insignificance is therefore justified (NIR, p.254). The ERT notes that the notation key “NE” should be used for PFC emissions from FK 5-1-12 used in magnesium dye casters in CRF table 2(II)B-Hs1. The Party reported emissions from the consumption of HFC-134a in CRF table 2(II)B-Hs1. These estimates are based on the assumption that 20 per cent of the gas consumed is emitted (1.60 t HFC-134a in 2017). HFC and/or PFC emissions from the decomposition of HFC-134a used in magnesium dye casters were identified as not occurring because no evidence was found for them (NIR, p.254). The ERT agrees with the Party’s assumptions and assessment.
I.7	2.D.2 Paraffin wax use – CO ₂ (I.20, 2017) Accuracy	Examine the availability of paraffin wax AD for the entire time series (1990–2015).	Resolved. The paraffin wax AD were revised on the basis of information provided by the United Kingdom energy statistics team for 1990–2015. The revised AD correspond to the data the Party reported to Eurostat. Emissions were recalculated on the basis of the revised AD, and information on the recalculations was provided in a transparent manner in the NIR (p.259).
I.8	2.D.2 Paraffin wax use – CO ₂ (I.20, 2017) Transparency	Explain the differences between the data from DUKES used for the inventory and Eurostat data.	Resolved. The United Kingdom provided an explanation of the differences between the data from DUKES used for the inventory and Eurostat data (NIR, p.258).
I.9	2.D.2 Paraffin wax use – CO ₂ (I.10, 2017) (I.18, 2016) (I.18, 2015) Accuracy	Examine possible sources of AD, especially the IEA (OECD), Eurostat and the United Nations Economic Commission for Europe questionnaires.	Resolved. The AD on paraffin wax use were revised for the period 2009–2017 on the basis of data provided by the United Kingdom energy statistics team. The AD used in the emission estimates now correspond to the AD the Party reported to Eurostat for the entire time series (1990–2017). As a result of the recalculations of the CO ₂ emissions from category 2.D.2 for the period 2009–2015, the emissions changed by between –4.21 to 12.65 kt CO ₂ (they increased in 2009 and 2013–2015, and decreased in 2010 and 2011).
I.10	2.D.3 Other (non-energy products from fuels and solvent use) – CO ₂ (I.21, 2017) Transparency	Describe in the NIR that CO ₂ emissions from urea use in Euro VI standard HGVs and buses are included in the reported estimates from urea use in road transport catalysts, that fuel consumption data are determined using the same approach as is described in the NIR for Euro IV and V HGVs and buses, but, in accordance with the <i>EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016</i> , a 3.5 per cent urea solution in fuel is considered, and that 100 per cent of Euro VI HGVs and buses are equipped with selective catalytic reduction abatement.	Resolved. The United Kingdom provided a description of the methodology used for estimating CO ₂ emissions from urea use in HGVs and buses to reflect that its inventory estimates also account for Euro VI standard vehicles using urea, and that fuel consumption by Euro IV, V and VI HGVs and buses was estimated using the same bottom-up methodology (NIR, p.260). The description of the applied methodology corresponds to the <i>EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016</i> .

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I.11	2.F.1 Refrigeration and air conditioning – HFCs (I.22, 2017) Transparency	Include in the NIR the scaling factors (e.g. population, gross domestic product) used to calculate emissions from refrigeration and air-conditioning equipment in overseas territories and Crown dependencies.	Resolved. The United Kingdom provided information on the scaling factors applied in calculating emissions from refrigeration and air-conditioning equipment in overseas territories and Crown dependencies (NIR, p.267). The following indicators were chosen: gross domestic product for refrigerated transport and commercial and industrial refrigeration; population for domestic refrigeration and stationary air conditioning; and number of vehicles for mobile air conditioning. During the review, the ERT evaluated the calculation of HFC emissions from refrigeration and air-conditioning equipment in overseas territories and Crown dependencies using these scaling factors. The ERT agrees with the Party's chosen approach and calculations.
I.12	2.F.1 Refrigeration and air conditioning – HFCs (I.23, 2017) Convention reporting adherence	Improve the description in the NIR of the tier level of the methodology that is applied for the estimation of emissions from subcategory 2.F.1, noting a tier 2a method, in line with the 2006 IPCC Guidelines, has been implemented.	Not resolved. The United Kingdom did not identify that a tier 2a method was applied for estimating emissions from category 2.F.1 in the corresponding section of the NIR (pp.264–265). During the review, the Party acknowledged the missing description of tier-level complexity for category 2.F.1.
I.13	2.G.2 SF ₆ and PFCs from other product use – SF ₆ and PFCs (I.24, 2017) Accuracy	Continue to include in the improvement plan the need for an update of the AD, based on actual consumption, for the estimation of SF ₆ and PFC emissions from semiconductor manufacture and report any progress thereon in the NIR.	Not resolved. The need for an update of the AD and emissions for semiconductor manufacture is stated in the United Kingdom's improvement plan, which was provided to the ERT during the review. The ERT noted, however, that the NIR does not include any evidence that progress has been made on this matter since the 2017 annual submission.
Agriculture			
A.1	3. General (agriculture) (A.6, 2017) Completeness	Estimate and report emissions from categories 3.F, 3.G and 3.H for overseas territories and Crown dependencies or, if they are considered insignificant, report them as "NE" and provide a detailed explanation in the NIR on the likely level of emissions from categories 3.F, 3.G and 3.H for overseas territories and Crown dependencies in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Addressing. The United Kingdom reported (1) GHG emissions from category 3.F (field burning of agricultural residues) for Crown dependencies (emissions occurred only between 1990 and 1993 (NIR p.327)), (2) CO ₂ emissions from category 3.G (liming) for Crown dependencies and (3) CO ₂ emissions from category 3.H (urea application) for overseas territories and Crown dependencies, excluding the Falkland Islands (Malvinas) and Bermuda. Emissions from the categories 3.F and 3.G for all overseas territories and from 3.H for some overseas territories are still not estimated owing to the lack of available AD and/or expert judgment. In the NIR, the Party reported that liming likely does not occur in the Falkland Islands (Malvinas) or Cayman Islands, while activity in Bermuda has not been estimated (p.328). The Party also reported that urea application is likely minimal or does not occur in the Falkland Islands (Malvinas) and Bermuda (p.329). The occurrence of emissions from liming and urea application for Gibraltar is not discussed in the NIR. The ERT concludes that the estimates for categories 3.F for all

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			overseas territories, 3.G for Bermuda and Gibraltar, and 3.H for the Falkland Islands (Malvinas) Bermuda and Gibraltar are not complete. The ERT notes that as the overseas territories and Crown dependencies represent a part of the United Kingdom's territory and that the Party already reports some emissions from sources under categories 3.F, 3.G and 3.H, the significance threshold cannot be applied to omit reporting of these areas, and therefore emissions for the overseas territories and Crown dependencies are to be calculated. The ERT notes that if data are not available for estimating emissions from the overseas territories with the same methodology as that applied for mainland United Kingdom, the Party could use expert judgment to derive quantitative data in order to estimate emissions with at least a tier 1 method for these areas. The ERT assesses that emissions for these territories are likely below the threshold of significance included in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines for the United Kingdom (237 kt CO ₂ eq in 2017) and therefore below the threshold for inclusion of this issue in the list of potential problems and further questions raised by the ERT in accordance with decision 22/CMP.1 in conjunction with decision 4/CMP.11, annex, paragraph 80(b).
A.2	3.A Enteric fermentation – CH ₄ (A.1, 2017) (A.2, 2016) (A.2, 2015) (65, 2014) (55, 2013) Accuracy	Implement the planned improvement of digestible energy data through the commissioned research projects.	Resolved. The United Kingdom revised the methodology for estimating emissions from enteric fermentation of dairy cows, beef cows and other cattle through implementing its revised agriculture sector model and improvements derived from extensive research by the Party into this category, including improved data on livestock types and numbers, digestible energy, gross energy intake, animal weight and other relevant parameters (NIR, pp.305–309).
A.3	3.A.2 Sheep – CH ₄ (A.2, 2017) (A.3, 2016) (A.3, 2015) (66, 2014) (56, 2013) Accuracy	Apply a methodology that more closely reflects the country-specific conditions, for instance by moving to the IPCC tier 2 methodology for the sheep subcategory, in addition to documenting national circumstances leading to methodological choice.	Resolved. The United Kingdom moved to the tier 3 methodology for the sheep subcategory in order to improve accuracy and better reflect country-specific circumstances (NIR, p.308).
A.4	3.A.4 Other livestock – CH ₄ and N ₂ O (A.3, 2017) (A.5, 2016) (A.5, 2015) Transparency	Fully document in the NIR (1) the method used to estimate the annual population of horses, deer and goats, including any adjustments to the original population data that the Party receives from national statistical agencies; and (2) the use of any additional data sources and estimations, as required by the	Resolved. The United Kingdom revised the methodology for estimating the annual horse population and presented details of how the AD were derived for all livestock types, including horses, deer and goats, in the NIR (pp.300–302). The Party reported that population numbers for the 2019 submission were obtained from the June Agricultural Census 2018, with missing data being gap-filled using a method described under Defra project AC0114.

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		2006 IPCC Guidelines (vol. 4, section 10.2.2 and equation 10.1).	
A.5	3.B.4 Other livestock (horses) – N ₂ O (A.4, 2017) (A.6, 2016) (A.6, 2015) Accuracy	Make efforts to determine the number of horses in stabling and the corresponding type of manure management in order to determine the fraction of the total amount of N excretion for each MMS for category 3.B.4 (manure management – horses).	Resolved. The United Kingdom revised the methodology for estimating manure management emissions from horses. In 2017, the distribution of MMS for horses was 30.1 per cent solid storage (stabling) and 69.9 per cent pasture range and paddock (NIR, p.313 and table A.3.3.5). The ERT concludes that the estimates of N excretion for each MMS for horses under category 3.B.4 are appropriate.
A.6	3.D.a – Direct N ₂ O emissions from managed soils – N ₂ O (A.7, 2017) Transparency	Provide in the NIR a complete reference to the data sources used, and a clear description of the method, assumptions and calculations used to calculate the country-specific EFs for inorganic fertilizer, animal manure applied to soils, and urine and dung deposited by grazing animals.	Resolved. The United Kingdom provided in the NIR a reference to the data sources and a description of the method, assumptions and calculations used for calculating the country-specific EFs for inorganic fertilizer (pp.319–320), animal manure applied to soils (p.320), and urine and dung deposited by grazing animals (p.320).
A.7	3.D.a.3 Urine and dung deposited by grazing animals – N ₂ O (A.5, 2017) (A.7, 2016) (A.7, 2015) Transparency	Provide complete references for the data sources, a clear description of the method, assumptions and calculations used, and an explanation for the difference between the country-specific EF and the default EF from the 2006 IPCC Guidelines.	Resolved. The United Kingdom included in the NIR a reference to the data sources and a description of the method, assumptions and calculations used for estimating the N ₂ O emissions from category 3.D.a.3 (p.320 and table A.3.3.7). The Party also included an explanation of the difference between its country-specific EF and the default EF from the 2006 IPCC Guidelines (NIR, p.320).
A.8	3.D.a.6 – Cultivation of organic soils (i.e. histosols) – N ₂ O (A.8, 2017) Transparency	Provide in the NIR an explanation and further supporting evidence for the classification of organic soils in the Falkland Islands (Malvinas) as unmanaged, and explain why the areas of organic soils in overseas territories and Crown dependencies are not included as a contributing source to N ₂ O emissions from the cultivation of organic soils.	Addressing. According to the NIR (p.446), information from the in-country contact and Falkland Islands Department of Agriculture website (http://www.fig.gov.fk/agriculture/) confirms that grassland on histosols is characterized as an extensive rangeland system that receives no fertilizer, liming, cultivation or drainage. According to the Party, although this system may technically qualify as “managed” under the IPCC definition as it is used for production, the rationale for calling it “unmanaged” is that there are no management activities that would lead to the release of N ₂ O following the loss of soil carbon. Cropland on cultivated histosols in the Falkland Islands (Malvinas) is a source of N ₂ O emissions, but these emissions are covered under category 3.J (other (CO ₂ emissions from liming, urea application and other carbon-containing fertilizers)). This explanation is provided in the NIR (pp.322 and 446). During the review, the United Kingdom provided to the ERT the worksheet used to estimate GHG emissions from overseas territories and Crown dependencies, where histosols areas and emissions are included. However, the Party has not included this information in its NIR or an explanation of the estimation of these sources.

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LULUCF			
L.1	4. General (LULUCF) 4.B Cropland 4.C Grassland – CO ₂ (L.1, 2017) (L.9, 2016) (L.9, 2015) Comparability	Report mineral and organic soils separately under cropland and grassland.	Addressing. The United Kingdom reported carbon stock changes from mineral and organic soils for cropland remaining cropland separately in CRF table 4.B, but for forest land, grassland and settlements converted to cropland, the areas of organic and mineral soils in the mainland United Kingdom were aggregated. For the overseas territories and Crown dependencies, only grassland is converted to cropland, and the corresponding carbon stock changes from mineral and organic soils were reported separately. For grassland, the areas of organic soil were aggregated with those of mineral soils and reported in CRF table 4(II). During the review, in response to a question from the ERT, the Party explained that emissions from mineral and organic soils in grassland would be reported separately in CRF table 4.C, as would information on the area of unimproved grassland on organic soils, when the results of a study (Evans et al., 2017) were implemented. The ERT acknowledges the progress of the United Kingdom in implementing the results of that study (see the box in section 6.5.8 of the NIR).
L.2	4. General (LULUCF) 4.B Cropland – CO ₂ 4.C Grassland – CO ₂ (L.2, 2017) (L.9, 2016) (L.9, 2015) Transparency	Assess the use of notation keys for the reporting of organic cropland and grassland soils, as appropriate.	Addressing. The United Kingdom used the notation key “NE” in CRF table 4(II) when carbon stock changes from organic soils in cropland and grassland were not reported owing to insufficient data and information, as reported in CRF table 9. For the overseas territories and Crown dependencies, the notation key “NO” was appropriately used for reporting carbon stock changes for all subcategories of cropland in CRF table 4.B except cropland remaining cropland and grassland converted to cropland, and the notation key “NO” was appropriately used for reporting carbon stock changes for all subcategories of grassland in CRF table 4.C. The notation key “IE” was used in all cases for mainland United Kingdom where mineral and organic soils were aggregated (area and emissions).
L.3	4. General (LULUCF) 4.B Cropland – CO ₂ 4.C Grassland – CO ₂ (L.21, 2017) Comparability	(a) Provide information in the NIR about areas of organic soils for all lands, separating drained and undrained cropland and grassland; (b) Report organic soils separately from mineral soils in CRF tables 4.B, 4.C and 4(II), including overseas territories and Crown dependencies; (c) Report CO ₂ emissions from organic soil drainage in CRF tables 4.B and 4.C, avoiding double counting of emissions in table 4(II);	(a) Not resolved. The United Kingdom did not provide in the NIR information on areas of organic soils for all land categories, or information on drained and undrained organic soils for grassland. Based on information provided by the Party during the review, all organic soils on cropland are assumed to be drained. The United Kingdom is finalizing and checking the results from the implementation of a study (Evans et al., 2017), which required modifying the dynamic soil carbon model to remove the organic soil component from the soil carbon stock calculations. The results of this research will enable all areas of organic soils to be defined and to be treated using a tier 2 approach;

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		(d) Provide an explanation in the NIR for the discrepancies between areas of organic soils reported in CRF table 3.D and in CRF tables 4.B, 4.C and 4(II).	<p>(b) Addressing. The United Kingdom reported areas and emissions separately for mineral and organic soils for cropland remaining cropland and grassland converted to cropland (only for overseas territories and Crown dependencies for the latter subcategory) in CRF table 4.B. For grassland remaining grassland, the areas and carbon stock changes of mineral and organic soils were reported together in CRF table 4.C for mainland United Kingdom. The Party continues to report mineral and organic soils together for conversions of wetlands and settlements to grassland for mainland United Kingdom. Emissions for aggregated mineral and organic soils were reported for forest land and cropland converted to grassland for mainland United Kingdom. During the review, the Party clarified that disaggregated reporting for SOC would be used for grassland in CRF table 4.C when the results of a study (Evans et al., 2017) were implemented. Separate information on the area of uncultivated organic soils would then also be provided. In CRF table 4(II) the United Kingdom reports “IE” for the area of drained organic soils in cropland, indicating that the areas are reported in cropland remaining cropland;</p> <p>(c) Addressing. The United Kingdom reported CO₂ emissions from the drainage of cropland organic soils in CRF table 4.B. For grassland, these CO₂ emissions were reported in CRF table 4(II). During the review, the Party indicated that it would report CO₂ emissions from grassland organic soils in CRF table 4.C in the next annual submission;</p> <p>(d) Addressing. The United Kingdom reported the area of cultivated organic soils in CRF table 3.D as 285.70 kha in 2017, and the sum of the organic cultivated soils in CRF tables 4.B (93.62 kha) and 4.II (192.87 kha) as 286.49 kha. During the review, the Party informed the ERT that the area in CRF table 3.D refers to mainland United Kingdom only and that the difference of 0.79 kha corresponds to the area of cultivated organic soils in the Falkland Islands (Malvinas). More information on the Falkland Islands (Malvinas) can be found in ID# A.8 above and should be considered when addressing this recommendation.</p>
L.4	4. General (LULUCF) (L.14, 2017) Convention reporting adherence	Correct the inconsistencies identified within the NIR in the general and sector-specific sections and between the NIR and the CRF tables (i.e. ensure consistency in the reporting of the area of wetlands between NIR table 6.1 and CRF table 4.D and the reporting of the trends for the forest land and cropland categories, and include WDR among the activities elected under	Resolved. All the areas of wetlands in NIR table 6.11 (table 6.1 in the 2017 annual submission) are consistent with the areas reported in CRF table 4.D for the overseas territories and Crown dependencies. The inconsistencies identified by the previous ERT in the trend discussion within various sections of the NIR and between the NIR and CRF table 10s1 have been eliminated and the trends are now described only once in the NIR (p.115). Finally, section 2.5 of the 2017 NIR has been removed; therefore, the specific omission in referencing WDR no longer exists.

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		Article 3, paragraph 4, of the Kyoto Protocol).	WDR has been included among the activities elected under Article 3, paragraph 4, of the Kyoto Protocol (e.g. in NIR table 1.2).
L.5	4. General (LULUCF) (L.15, 2017) Convention reporting adherence	Implement a significance analysis to determine which carbon pools and subcategories are significant in each key category using the guidance provided in the 2006 IPCC Guidelines, and provide in the NIR detailed information on the results of the analysis.	Not resolved. The United Kingdom did not implement a significance analysis to determine which carbon pools and subcategories are significant. However, the Party informed the ERT during the review that it is presently carrying out an analysis of uncertainties from the CARBINE model, which will be used in the key category analysis to identify significant pools and subcategories. The ERT acknowledges the advances made by the United Kingdom in this regard and commends the Party for its efforts to resolve this issue.
L.6	Land representation – CO ₂ (L.4, 2017) (L.19, 2016) (L.19, 2015) Completeness	Provide estimates of emissions and removals for the missing land areas (Bermuda, Cayman Islands, Gibraltar and Montserrat).	Addressing. The United Kingdom is working with the Governments of the Cayman Islands and Bermuda to obtain the AD necessary for estimating GHG emissions and removals in these overseas territories (NIR, p.463). The ERT notes that Bermuda and Montserrat are not within the scope of the United Kingdom's GHG inventory reporting under the Kyoto Protocol and Montserrat is not within the scope of its reporting under the Convention (see https://treaties.un.org/Pages/ViewDetailsIII.aspx?src=IND&mtdsg_no=XXVII-7&chapter=27&Temp=mtdsg3&clang=en#7). Gibraltar has made its own LULUCF calculations and indicated that no changes in carbon stock occur in the territory, which is extremely small (6 km ²) (NIR, annexes, p.755). The ERT is of the view that the fact that the territory is small does not imply that emissions from LULUCF do not occur, and that data are necessary to support this statement. During the review, the Party informed the ERT that it would continue to explore potential sources of data and information to inform estimates of emissions and removals in the missing land areas.
L.7	Land representation (L.16, 2017) Convention reporting adherence	Correct all inconsistencies with regard to the representation of land use and land-use changes. In particular: (a) Report, for all land-use categories, final land areas each year in CRF table 4.1 that equal initial land areas in the next year; (b) Report, for all land-use categories, final land areas for each year in CRF table 4.1 that equal the total land areas in the background sectoral CRF tables 4.A–4.F; (c) Report all land areas under their territorial coverage (United Kingdom, overseas territories and Crown dependencies) in CRF table	(a) Resolved. All final land areas reported in CRF table 4.1 for a certain year (from 1990 to 2017) correspond to the initial land areas reported in the following year; (b) Addressing. The issue has been resolved for all land areas except grassland. The final land area for each year in CRF table 4.1 for grassland is not equal to the total land area reported in CRF table 4.C. For all years since 1990, the difference between the area reported in CRF table 4.1 and in CRF table 4.C is equal to 192.87 kha (e.g. for 2017, the final grassland area reported in CRF table 4.1 and in CRF table 4.C is 14,661.77 and 14,468.90 kha, respectively). During the review, the United Kingdom explained that the inconsistency in the area reported is due to the fact that the area of organic soils in grassland remaining grassland has been incorrectly reported: it does not

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		4.1 and the background sectoral CRF tables 4.A–4.F; (d) Ensure that the total country area reported in CRF table 4.1 and the background sectoral CRF tables 4.A–4.F remains constant throughout the time series.	include the area of grassland organic soils reported in CRF table 4(II); (c) Resolved. CRF table 4.1 reports the areas for all of the United Kingdom, including the overseas territories and Crown dependencies, and the background sectoral CRF tables 4.A–4.F provide separate estimates for mainland United Kingdom, the overseas territories and the Crown dependencies; (d) Not resolved. The total country area reported in CRF table 4.1 for 1990–2007 is 25,731.23 kha, for 2007–2009 is 25,731.27 kha, for 2010–2013 is 25,731.29 kha and is 25,731.35 kha thereafter. In addition, as noted in item (b) above, the total area of grassland reported in CRF table 4.1 for the entire period 1990–2017 does not match the total area of grassland reported in CRF table 4.C (e.g. for 2017, 14,661.77 kha of grassland was reported in CRF table 4.1, whereas 14,468.90 kha was reported in CRF table 4.C).
L.8	Land representation (L.16, 2017) Transparency	Provide in the NIR detailed information on how the data sources have been combined to estimate land areas and on the methodology followed for the development of the land-use conversion matrix.	Resolved. The United Kingdom provided consistent annual transition matrices for the period 1990–2017 for mainland United Kingdom in NIR table 6.3 and for overseas territories and Crown dependencies in NIR table 6.11. The Party provided information in the NIR on the approach taken to generate the transition matrices (pp.333–334) and detailed information on how the different sources of data indicated in NIR table 6.2 were combined (annexes A.3.4.2.1 and A.3.4.2). The Party also reported methodological developments undertaken to improve the estimation of land-use change using Bayesian assimilation of multiple land-use data sets (NIR, p.334). The ERT understands that improvements to land use and land-use change are still in process.
L.9	4.A Forest land – CO ₂ (L.5, 2017) (L.2, 2016) (L.2, 2015) (76, 2014) Transparency	Continue efforts to gather information on the management of privately owned forests and include in the NIR information on the management prescriptions and rotation ranges.	Resolved. The United Kingdom provided additional information on AD related to the management of forests and rotation ranges, including for privately owned forests (NIR, annexes, p.723). Information on the management of privately owned forests, which informs the inventory estimates, and a description of how AD for forest land (forest land remaining forest land and land converted to forest land) are derived are included in the National Forest Accounting Plan (available at https://www.gov.uk/government/publications/uk-national-forestry-accounting-plan-2021-to-2025).
L.10	4.A Forest land – CO ₂ (L.7, 2017) (L.12, 2016) (L.12, 2015) Transparency	Include additional information on the management of privately owned forests in the NIR, specifically that: (a) Privately owned forests are assigned a species based on the National Inventory of Woodland	(a) Resolved. The National Forest Accounting Plan referenced in the NIR (annexes, p.723) provides information on the assumptions (including on species and distribution of growth rates) made for privately owned forests (see, e.g., information on pp.25 and 27 of the Plan); (b) Resolved. See item (a) above;

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		<p>and Trees species survey, then mapped to species for which the United Kingdom has suitable growth models;</p> <p>(b) The distribution of growth rates for these species is assumed to be the same as on the public forest estates for each devolved administration (Scotland, Wales, Northern Ireland, England);</p> <p>(c) The overall percentage of woodland being managed for wood production is estimated so as to calculate wood production over the period that is consistent with the wood production statistics;</p> <p>(d) The rotation lengths are based on the age of maximum mean annual increment, with a range to match the given age distribution and planting records.</p>	<p>(c) Resolved. See item (a) above and also ID# L.15 below regarding the “Reconcile” methodology improvement used for estimating wood production in a manner consistent with wood production statistics;</p> <p>(d) Resolved. Information on rotation lengths in privately owned forests is provided in the National Forest Accounting Plan (referenced in the NIR (annexes, p.723)). For instance, on page 34 of the Plan it is stated that rotations for private forests in England, Scotland and Wales are based on those that were assigned to forest areas as part of a forecasting exercise carried out by the Forestry Commission for the private sector in 2006 (Halsall et al., 2006). These rotations were characterized through consultation with forestry sector expert groups in England, Scotland and Wales, and represent the best available proxy for rotations applied in areas managed for production in private sector forests for the period 2000–2009. Information on rotation lengths for privately owned forests in the United Kingdom is also provided in the Plan.</p>
L.11	4.A Forest land (L.8, 2017) (L.13, 2016) (L.13, 2015) Transparency	Include information in the NIR on how data for the areas of forest land remaining forest land and land converted to forest land for the period 1990–1999 were calculated, and provide a more concise description of how the areas for different categories (forest land remaining forest land and land converted to forest land) have been estimated for 1990 onward.	Resolved. The United Kingdom in annex 3.4 to the NIR provided a description of how land areas were derived for the entire time series, and further information is provided in the National Forest Accounting Plan referenced in the NIR (annexes, p.723) (see ID# L.9 above).
L.12	4.A Forest land – CO ₂ (L.9, 2017) (L.15, 2016) (L.15, 2015) Convention reporting adherence	Include information in the NIR on the verification of all carbon stock changes estimated using tier 3 methods and/or models (CARBINE, C-Flow and BSORT models).	Addressing. The United Kingdom provided some information on the verification of carbon stock changes in several sections of the NIR (6.2.6 (forest land), 6.3.6 (cropland) and 6.4.6 (grassland)). During the review, the Party provided additional information on the verification of the models, and a draft of a report providing comparisons of the CARBINE, C-Flow and BSORT models (Matthews et al. (2019), which was not yet published but is an update of and has similar results to Matthews et al. (2017)). The United Kingdom indicated that it is making continuous progress toward verifying the models used in the national inventory and would include the results of this exercise in future annual submissions.
L.13	4.A Forest land – CO ₂ (L.17. 2017) Accuracy	Obtain the necessary input data so as to be able to apply the CARBINE model for estimating carbon stock changes in forest land in overseas territories and Crown dependencies.	Addressing. During the review, the United Kingdom indicated that it had attempted but was unable to collect the input data necessary to apply the CARBINE model for estimating carbon stock changes in forest land in overseas territories and Crown dependencies. The Party explained the difficulties in using the CARBINE model for estimating carbon stock changes in

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			these lands owing to the lack of documentation and necessary input data for the model. The ERT had extensive discussions on this matter with the Party's LULUCF experts during the review. The ERT recognizes the difficulties in acquiring the necessary input data and the implications regarding the cost-effectiveness of doing so, and is of the view that the United Kingdom could apply a simpler approach, yet consistent with good practice, to estimating the changes in carbon stock in forest land in overseas territories and Crown dependencies. For example, the Party could assess whether data are available that would allow tier 1 methods from the 2006 IPCC Guidelines to be applied.
L.14	4.A Forest land – CO ₂ (L.18. 2017) Completeness	Estimate and report carbon stock changes in biomass from forests not used for timber production in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 4) owing to biomass losses associated with harvesting and/or gathering (e.g. fuelwood) or provide transparent information justifying that such losses are not occurring.	Addressing. The United Kingdom reported that no reliable estimates are currently available for the quantity of wood removed by gathering or disturbances and hence it cannot provide estimates for the changes in carbon stock in biomass from forests not used for timber production (NIR, p.449); however, the CARBINE model provides estimates of the carbon increment of forests not used for timber production. The NIR further states that the second cycle of the NFI (2015–2020), currently under way, would provide additional information that is expected to allow the estimation of carbon stock changes in biomass from forests not used for timber production owing to biomass losses associated with harvesting and/or gathering.
L.15	4.A.1 Forest land remaining forest land – CO ₂ (L.19. 2017) Consistency	Adjust wood harvest data derived from the modelling of the management of forests to take into account data from recent forest inventories (NFI in 2011 and an inventory of the Public Forest Estate in 2014) in order to avoid an inconsistent time series, using the overlap or any other method consistent with those described in the 2006 IPCC Guidelines (vol. 1, chap. 5).	Addressing. The ERT notes that an inconsistency in the time series remains for carbon stock change in litter per area: between 2012 (0.07 t C/ha) and 2013 (0.04 t C/ha). The ERT acknowledges the efforts made by the United Kingdom to implement an automated algorithm for adjusting the modelled and reported levels of timber production (NIR, p.340). During the review, the Party provided the ERT with a 2019 internal report on the “Reconcile” methodology improvement that introduces the automated algorithm and its inputs. The report found when testing the algorithm against the CARBINE model that the automated algorithm produces the same results as the CARBINE model. The automation of Reconcile-generated estimates for fell volume, rotation offset, the percentage of forest in the private sector that is not managed for timber production, and rotation spread for England, Scotland and Wales provided a better fit between the softwood and hardwood volume production and the modelled volumes relative to the modelled estimates in the 2017 annual submission. Reconcile takes into account data from the NFI and the Party mentioned that the Subcompartment Database provides the data for the Public Forest Estate but did not explain what

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			the database is. The United Kingdom informed the ERT that this issue would be addressed with the final version of the Reconcile project.
L.16	4.A.2.5 Other land converted to forest land – CO ₂ (L.20, 2017) Accuracy	Develop the necessary AD for the original land-use category currently reported in other land converted to forest land and allocate these land areas to the appropriate land-use conversion category when developing the land-use conversion matrix, or alternatively, if this is not possible, reclassify this land-use change as grassland converted to forest land, given that the grassland category is used as the buffer category.	Resolved. The United Kingdom reclassified the area previously reported as other land converted to forest land to grassland converted to forest land.
L.17	4.B Cropland – CO ₂ (L.10, 2017) (L.5, 2016) (L.5, 2015) (81, 2014) (83, 2013) Comparability	Assign orchards to cropland and provide documentation on the method used to estimate the carbon stock changes over time, and ensure that changes in the area of orchards over time have been taken into account.	Resolved. The United Kingdom allocated orchards to cropland across the time series and explained in the NIR that it used the annual agricultural census data to estimate areas and changes in carbon stock in biomass in cropland over time (NIR, p.347).
L.18	4.B Cropland – CO ₂ (L.11, 2017) (L.16, 2016) (L.16, 2015) Comparability	Report CO ₂ emissions from all organic cropland soils in CRF table 4.B.	Resolved. The United Kingdom reported all CO ₂ emissions in cropland organic soils in CRF table 4.B, even those that result from the drainage of cropland organic soils, which are reported in CRF table 4(II) using the notation key “IE”.
L.19	4.B Cropland – CO ₂ (L.22, 2017) Accuracy	Incorporate data from NIR table A.3.4.20 into NIR tables A.3.4.15–A.3.4.18 and revise carbon stock changes in living biomass from land conversions to and from cropland.	Resolved. The United Kingdom applied in the 2019 annual submission consistent country-specific living biomass carbon stocks arising from land-use change and management. The average living biomass densities for cropland used in the non-forest biomass land-use change model were updated to those used in the CM calculations (which were based on the review of country-relevant literature in Moxley et al., 2014) (NIR, p.349). The biomass carbon stock change factors are appropriately presented in NIR table A.3.4.15 for cropland in the United Kingdom and a new table, A.3.4.18, for the mean biomass carbon stock densities for England, Scotland, Wales and Northern Ireland, is provided.
L.20	4.B.1 Cropland remaining cropland – CO ₂ (L.23, 2017) Accuracy	Develop country-specific EFs for manure and residue inputs or continue to investigate the appropriateness of the application of default EFs to reference SOC stocks for 1 m layer soil.	Addressing. The United Kingdom continues to estimate carbon stock changes after management change in cropland using soil carbon stocks (SOC) for 1 m layer soil together with default EFs from the 2006 IPCC Guidelines, which were developed for 0–30 cm soil depth. As noted in the previous review report, a study carried out in the United Kingdom concluded that the IPCC default EFs for manure and residue inputs may not be applicable for the entire country owing to limited available data (Defra, 2012). During the review, the Party informed the ERT that country-specific SOC stocks up to 30 cm are

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			being estimated and would be applied in future submissions.
L.21	4.B.1 Cropland remaining cropland – CO ₂ (L.24, 2017) Transparency	Include in the NIR information on the calculation of carbon stock changes of different components of living biomass of cropland (e.g. transitions among orchards, annual cropland and shrubby perennial crops).	Resolved. The United Kingdom included information on the calculation of carbon stock changes of different components of living biomass of cropland in the NIR (annexes, p.737). The crop types from the agricultural surveys are grouped into four broad categories (see figure A.3.5 and table A.3.4.14 in the NIR). Tier 2 biomass carbon stock change factors (table A.3.4.15) are used for estimating the total biomass carbon stocks and the annual change in biomass carbon stocks.
L.22	4.C Grassland – CO ₂ (L.25, 2017) Comparability	Allocate rural hedges to settlements or grassland, ensuring time-series consistency of the accounting of these areas to a single land-use category, and clearly indicate in the NIR where they are included.	Not resolved. The United Kingdom reported that hedgerows, currently allocated to the settlements category, would be allocated consistently to the grassland category in the next annual submission (NIR, p.357). The ERT notes that even though these areas are reported under settlements, the changes in carbon stock are accounted for under grassland (see ID# KL.17 below).
L.23	4.C.2.1 Forest land converted to grassland – CO ₂ (L.26, 2017) Completeness	Report carbon stock changes from the dead organic matter and mineral soils pools for overseas territories and Crown dependencies.	Resolved. Changes in carbon stock in the dead organic matter pool for overseas territories and Crown dependencies are reported in CRF table 4.C for forest land converted to grassland for the years 2000–2017 (0.04 kt C in 2017). For the changes in carbon stock in mineral soils, the notation key “NO” is applied for this same time series, since the change in forest cover is a result of the changed areas losing sufficient tree cover to be reclassified as dense scrub or parkland, rather than conversion.
L.24	4.C.2.3 Wetlands converted to grassland – CO ₂ , CH ₄ and N ₂ O (L.27, 2017) Transparency	Include in the NIR detailed information on the methodology applied and assumptions used for classifying abandoned peat extraction sites as wetlands converted to grassland, noting that in accordance with the 2006 IPCC Guidelines (vol. 4, section 7.2) GHG emissions from post-extraction lands continue and should be reported as long as the land is not converted to another use.	Resolved. The United Kingdom reported that any peat extraction sites abandoned since 2002 for which a change of land use cannot be identified are still judged to be producing on-site emissions. The ERT notes that this is in line with the 2006 IPCC Guidelines (vol. 4, section 7.2) and the IPCC <i>Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories</i> (NIR, annexes, p.751). A time series was constructed using linear interpolation. The extraction area (active and abandoned areas where there has been no change in land use) decreased between 1990 and 2015 by 40 per cent in England, 43 per cent on fuel peat sites in Scotland, 6 per cent on horticultural peat sites in Scotland, 99 per cent on fuel peat sites in Northern Ireland and 40 per cent on horticultural peat sites in Northern Ireland. These former extraction areas were assumed to have been converted to grassland.
L.25	4.D. Wetlands – CO ₂ , CH ₄ and N ₂ O (L.28, 2017) Completeness	(a) Collect the necessary data to enable reporting of emissions/removals from peat extraction remaining peat	(a) Addressing. The United Kingdom provided information on peat extraction in overseas territories and Crown dependencies in the NIR (annexes, p.756). Peat organic soils occur in the Falkland Islands (Malvinas) and the Isle of Man but not in the other overseas territories and

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		extraction in overseas territories and Crown dependencies; (b) Until then change the notation key in CRF table 4.D for the overseas territories and Crown dependencies from “NO” to “NE”.	Crown dependencies. Information on the extent and condition of peat soils in these territories was compiled as part of a research project on the implementation of the Wetlands Supplement (see the box on p.361 of the NIR). Further work is under way to incorporate these results into the annual submission. Further research on the peat soils of the Falkland Islands (Malvinas) is also under way and will be used to improve reporting in this category in future submissions; (b) Resolved. The area of organic soils as well as carbon stock changes in organic soils on peat extraction lands remaining peat extraction lands are reported in CRF table 4.D using the notation key “NE” for the overseas territories and Crown dependencies.
L.26	4.D. Wetlands – CO ₂ , CH ₄ and N ₂ O (L.28, 2017) Transparency	Provide in the NIR detailed information to describe that land conversion to peat extraction in overseas territories and Crown dependencies is not occurring.	Not resolved. The United Kingdom provided no detailed information in the NIR, but during the review indicated that, to the best of its knowledge, the Isle of Man and the Falkland Islands (Malvinas) are the only overseas territories and Crown dependencies with large areas of inland organic soils. The study of Evans et al. (2017) assessed the extent and condition of peatland and emissions from organic soils for the Isle of Man, which was assessed as having 0.001 kha domestic (non-commercial) peat extraction with no conversion to peat extraction occurring since 1990. No comprehensive, reliable data were available for the Falkland Islands (Malvinas), but personal communications with local land experts established that there is no commercial peat extraction, and only very limited domestic peat extraction. According to the Party, emissions from organic soils in the Falkland Islands (Malvinas) will be estimated once AD become available, which will not be before the 2022 submission.
L.27	4.D.1 Wetlands remaining wetlands – CO ₂ , CH ₄ and N ₂ O (L.29, 2017) Completeness	Report areas of flooded land remaining flooded land for overseas territories and Crown dependencies and the associated emissions, or, if that is not possible, report in the NIR on the progress in collecting suitable data in order to estimate emissions and removals from flooded land remaining flooded land for overseas territories and Crown dependencies.	Addressing. The United Kingdom reported that an assessment of flooded land was undertaken for the overseas territories and Crown dependencies and that none of the flooded land areas exceeded the area threshold of 1 km ² used for the United Kingdom (NIR, annexes, pp.755–756). Hence, the area of flooded land remaining flooded land was included as part of the inland water area and reported under category 4.D.1.3 (other wetlands remaining other wetlands) (0.095 kha in total). Emissions from flooded land remaining flooded land in overseas territories and Crown dependencies were reported as “IE” in CRF table 4.D, with a comment indicating that emissions are reported under category 4.D.1.3. However, CO ₂ , CH ₄ and N ₂ O emissions from category 4.D.1.3 are reported as “NO”.

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L.28	4 (V) Biomass burning – CO ₂ , CH ₄ and N ₂ O (L.30, 2017) Completeness	Assess the areas of and emissions from wildfires on forest land remaining forest land, land converted to forest land, grassland remaining grassland and land converted to grassland for all overseas territories and Crown dependencies.	Addressing. The United Kingdom provided additional detailed information regarding the estimation of the areas of and associated emissions from wildfires in overseas territories and Crown dependencies (NIR, annexes, pp.755–756). As little information exists on wildfires in the overseas territories and Crown dependencies, the Party used pro-rata rates of burning in the different land cover types in the United Kingdom as proxies for biomass burning in the overseas territories and Crown dependencies. Using this approach, the Party estimated the area of burned grassland in the overseas territories and Crown dependencies to be 0.961 kha/year, with estimated emissions of 1.28 kt CO ₂ eq. A similar approach was used for estimating the area subject to wildfires and associated emissions in forest land: the area of burned forest land in the Crown dependencies (the Falkland Islands (Malvinas) have no forest cover) was estimated to be <0.001 kha/year. The emissions associated with burning and wildfires for the overseas territories and Crown dependencies were reported in CRF table 4(V) as “NE”, because the United Kingdom assumed that the estimates fell below the significance threshold set out in decision 24/CP.19, annex, paragraph 37(b). The ERT considers that the use of the significance threshold is not applicable to parts of a territory only and concludes that these emissions should be reported in CRF table 4(V) (see ID# G.11 in table 5).
L.29	4.G HWP – CO ₂ (L.31, 2017) Transparency	Include in the NIR information on how the conversion factors for HWP are derived.	Resolved. The United Kingdom used the 2006 IPCC Guidelines default values for HWP conversion in the 2019 annual submission (NIR, p.452).
L.30	4.G HWP – CO ₂ (L.32, 2017) Accuracy	Correct the error in the HWP submodel in order to take into account the decay in HWP from the beginning of each year, and provide in the NIR detailed, transparent and verifiable information in accordance with paragraph 41 of the UNFCCC Annex I inventory reporting guidelines.	Resolved. The error was corrected in the 2018 annual submission. Each wood product category has its own carbon retention curve using the default half-lives in the Kyoto Protocol Supplement: 35 years for sawn wood, 25 years for wood panels and 2 years for paper. Timber used as fuelwood is assumed to be instantaneously oxidized. More explanatory text has been added to annex 3.4 to the 2019 NIR consistent with the use of the IPCC default factors (see ID# L.29 above).
L.31	4.G.3 Other (HWP) – CO ₂ (L.13, 2017) (L.18, 2016) (L.18, 2015) Transparency	Include verifiable production data from the CARBINE model and the corresponding factors used to convert the production data to carbon, and report those data in CRF table 4.Gs2 to enable a more thorough verification of the HWP estimates.	Addressing. The accuracy issue has been resolved as the United Kingdom provided in CRF table 4.Gs2 verifiable production data for 1990–2017 based on the outputs of the “Reconcile” methodology improvement (NIR, p.340) (see ID# L.15 above), but the Party did not provide in CRF table 4.Gs2 the factors used for converting the production data to carbon. The ERT notes that data prior to 1990 have not been provided in CRF table 4.Gs2 as reported in the 2017 annual submission.

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Waste			
W.1	5.A Solid waste disposal on land – CH ₄ (W.1, 2017) (W.2, 2016) (W.2, 2015) (91, 2014) (98, 2013) Transparency	Implement the proposed improvements of the emission estimates for solid waste disposal sites in the overseas territories and Crown dependencies by providing further information on the methodologies used to estimate the emissions and by completing the CRF tables with specific parameters such as AD, MCF and DOC.	Addressing. The United Kingdom described the methodology and parameters used for estimating the emissions from solid waste disposal sites in the overseas territories and Crown dependencies in NIR table A.3.5.5, but did not report the AD, MCF and DOC for the overseas territories and Crown dependencies. The AD were reported for the United Kingdom only in CRF table 5.A. During the review, the Party explained that the emissions from overseas territories and Crown dependencies represent only a small contribution to the total national emissions, therefore, the Party has given low priority to this issue. While acknowledging that the CH ₄ emissions reported in CRF table 5.A include emissions from the overseas territories and Crown dependencies, the ERT considers that for this issue to be resolved, the AD, MCF and DOC assumed for the overseas territories and Crown dependencies must be included in the NIR and the documentation box reported in CRF table 5.A should reference the data in the NIR.
W.2	5.A Solid waste disposal on land – CH ₄ (W.2, 2017) (W.5, 2016) (W.5, 2015) Transparency	Include in the NIR information on the parameters used in the MELMod model, including the exact figures and background information on their origin or method of derivation, and a weblink to the report on the review of landfill CH ₄ emission modelling.	Addressing. The United Kingdom explained the use of the tier 2 methodology, including equations from the IPCC FOD methodology, for calculating CH ₄ generation from solid waste disposal in the NIR (p.379). The Party provided background information on the input parameters, including DOC, DOC _f and the composition of waste materials (NIR table 3.5.2), the MCF and the fraction of CH ₄ in generated landfill gas; however, it did not provide background information on the oxidation factor used in equation 3.1 (p.380) and the decay rate constant (k) in equations 3.4 and 3.5 (p.381) of the MELMod model. The weblink to the report on the review of landfill CH ₄ emission modelling is included in the NIR (p.541). During the review, the Party provided background information on the k value and oxidation factor used in the model. The ERT considers that providing such information in the NIR would resolve this issue (see ID# W.16 in table 5).
W.3	5.A Solid waste disposal on land – CH ₄ (W.11, 2017) Transparency	Include in section 7.2.2 of the NIR how equations 3.1 to 3.6 from the 2006 IPCC Guidelines (vol. 5) are adapted for use in the MELMod model (i.e. provide more information on equation parameters removed or added) and how model verification is conducted in line with paragraph 41 of the UNFCCC Annex I inventory reporting guidelines on the verification of higher-tier methods and models.	Resolved. The United Kingdom explained how it applied equations 3.1 to 3.6 as contained in the 2006 IPCC Guidelines for calculating CH ₄ generation from solid waste disposal in the NIR (p.380). Regarding verification of the MELMod model, the Party explained in the NIR (p.386) that the model was peer reviewed in 2011 and 2014, and referenced the reviews (Eunomia Consulting and Research, 2011; Gold Associates, 2014). The emissions of the United Kingdom calculated using the model were compared with those of two countries with a similar history of landfill operations (Ireland and Italy); the results of the comparison suggest

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			that the emissions of the United Kingdom are in the same range as those of the similar countries considered.
W.4	5.A Solid waste disposal on land – CH ₄ (W.12, 2017) Transparency	Change the text in NIR table 5.A (p.414), which shows the improvements in the waste sector estimates, from “The methodology for calculating CH ₄ production in landfill sites has been updated” to “The input data and parameters for the MELMod model were updated based on new data” to reflect that updates in the MELMod model focused on input data and parameters and not on the methodology itself.	Resolved. The United Kingdom changed the text in NIR table 5.A accordingly.
W.5	5.A Solid waste disposal on land – CH ₄ (W.13, 2017) Transparency	Include in the NIR information on energy recovered from landfill gas and a cross reference to the category in the energy sector where emissions from CH ₄ recovered (from landfill gas) and used for power generation are reported.	Resolved. The United Kingdom reported the amount of CH ₄ used for power generation in NIR table A.3.5.4. The amount of renewable energy generated (4,284 GWh in 2017) from the combustion of landfill gas was obtained from United Kingdom energy statistics, according to the NIR (p.383). A cross reference was added to the waste chapter (p.378) to indicate that emissions from the use of landfill gas to generate power are reported under category 1.A.1.a (public electricity and heat production) in the energy sector.
W.6	5.B. Biological treatment of solid waste – CH ₄ and N ₂ O (W.14, 2017) Transparency	Provide in sections 7.3.2 and 7.3.5 of the NIR details on how AD are collected to enable the split of mechanical–biological treatment process emissions between composting and anaerobic digestion at biogas facilities.	Resolved. The United Kingdom reported the methodology for collecting AD for composting, for mechanical biological treatment and whether the treatment is anaerobic or aerobic and for anaerobic digestion at biogas facilities in the NIR (pp.388–389). The previous recommendation that the Party update section 7.3.5 of the NIR on recalculations was specific to the 2017 annual submission; the description of the recalculations of the AD for the time series does not apply to the 2019 annual submission.
W.7	5.D.1 Domestic wastewater – CH ₄ (W.8, 2017) (W.9, 2016) (W.9, 2015) Transparency	Include information in the NIR on population number connected to a septic system, as well as the BOD values applied.	Resolved. The United Kingdom reported the population connected to septic systems and the BOD values applied in the NIR (table A.3.5.12).
W.8	5.D.1 Domestic wastewater – CH ₄ (W.15, 2017) Comparability	Report AD for domestic wastewater in BOD, and ensure that the organic product in private wastewater treatment systems is included in the total organic product.	Addressing. The United Kingdom reported AD for sludge treatment and disposal as total dissolved solids (NIR table A.3.5.10) and BOD for private wastewater treatment systems (NIR table A.3.5.12). The summation of AD from both sources is reported in CRF table 5.D as DC because the Party assumes that total dissolved solids are comparable with BOD. The ERT considers that this assumption is not correct and that the use of total dissolved solids as AD in CRF table 5.D is not in line with the 2006 IPCC Guidelines. The ERT confirmed that the total organic product reported in CRF

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			table 5.D includes the organic product in private wastewater treatment systems.
W.9	5.D.1 Domestic wastewater – CH ₄ (W.19, 2017) Comparability	Report CH ₄ recovery consistent with the energy statistics.	Not resolved. The United Kingdom calculated the amount of CH ₄ recovery from domestic wastewater (2.62 kt in 2017, CRF table 5.D) as the difference between the estimated amount of CH ₄ produced from digestion and the reported CH ₄ emissions from wastewater treatment facilities. In the energy sector, the amount of sewage gas is based on data from DUKES (346 ktOE in 2017). During the review, the Party explained that the amounts of CH ₄ recovery and sewage gas are reported independently. The ERT notes that the energy content of the reported amount of sewage gas is much higher than that of recovered CH ₄ .
W.10	5.D.1 Domestic wastewater – N ₂ O (W.9, 2017) (W.10, 2016) (W.10, 2015) Transparency	In the NIR, provide a detailed description and justification for the update of the fraction of N in protein (1.16) and the fraction of industrial and commercial co-discharged protein (1.25) and information on the consideration of sludge incineration and sludge spreading on agricultural lands, and update the CRF tables accordingly.	Resolved. The United Kingdom reported the N ₂ O emissions from sewage sludge under category 5.D.1 as the difference between total N ₂ O emissions from sewage sludge and the estimated CH ₄ emissions from sludge spread on agricultural lands (reported under category 3.D.a.2.b (sewage sludge applied to soils)) and from sludge incineration (reported under category 5.C.1 (waste incineration)). An explanation of the use of the fraction of municipal N load from unconsumed protein (1.16) and the fraction of municipal N load from commercial and industrial sources (1.25), as referenced in the 2006 IPCC Guidelines, along with information on the consideration of sludge incineration and sludge spreading on agricultural lands, is included in the NIR (p.404). The values in CRF table 5.D have been updated for the entire time series.
W.11	5.D.1 Domestic wastewater – N ₂ O (W.16, 2017) Transparency	Include in CRF table 5.D the values of Frac _{NON-CON} and Frac _{IND-COM} applied.	Resolved. The values of Frac _{NON-CON} (1.16) and Frac _{IND-COM} (1.25) are reported in CRF table 5.D for the entire time series (1990–2017).
W.12	5.D.1 Domestic wastewater – N ₂ O (W.17, 2017) Accuracy	Exclude N removed with sludge in the calculation of the emission estimates for the waste sector, as suggested by equations 6.7 and 6.8 in the 2006 IPCC Guidelines, and report the AD in the relevant CRF table.	Not resolved. N removal of sludge is implicitly estimated by removing N ₂ O emissions associated with sewage sludge spread on agricultural land or incinerated, but this is not a robust N-balance in accordance with the 2006 IPCC Guidelines. During the review, the Party explained that the amount of sludge produced at wastewater treatment facilities was reported by law by each operator to the water authority. However, information on the N content of recovered sludge or during tertiary treatment was not available to the inventory team and so a conservative estimation, assuming only N emitted as N ₂ O from land spreading and incineration was removed with sludge, was used. The Party also explained during the review that the gathering of information from wastewater treatment facilities is considered in the future inventory improvement plan.

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W.13	5.D.2 Industrial wastewater – CH ₄ (W.10, 2017) (W.11, 2016) (W.11, 2015) Accuracy	Report on any progress in collecting the data needed to report AD and emissions from industrial wastewater separately from domestic wastewater.	Not resolved. The United Kingdom reported that no information is available on how much wastewater from the chemical and food and drinks industries are treated on site and how much wastewater is included in emissions from wastewater sent to sewers (NIR, p.406). IPCC default values for the amount of wastewater produced per tonne of output and COD in organic chemical production, and total organic load for food and drink industry subcategories from a United Kingdom study (Defra, 2002) are used and provided for the time series in NIR table A.3.5.13. The Party assumes all wastewater is treated separately on site. During the review, the Party explained that this issue is being considered as part of a wider wastewater improvement under the United Kingdom's GHG inventory improvement programme and that the wastewater improvement would be implemented subject to identified priorities and available resources. The ERT notes that the Party's current methods lead to a possible double counting of emissions between domestic and industrial wastewater and therefore this is not a potential problem.
W.14	5.D.2 Industrial wastewater – CH ₄ (W.20, 2017) Accuracy	Collect information on the proportions of aerobic and anaerobic treatment systems and revise the MCF used accordingly.	Not resolved. The United Kingdom reported that no country-specific information is available on the split of aerobic and anaerobic treatment systems (NIR, p.406); therefore, an IEF of 0.175 kg CH ₄ /kg DC derived from an MCF of 0.7 and the IPCC default CH ₄ potential (B ₀) for industrial wastewater (0.25 kg CH ₄ /kg DC) (2006 IPCC Guidelines, vol. 5, p.6.21) was used for estimating emissions for this category, which is a conservative value considering that aerobic treatment systems are used in many high BOD-emitting industries in the country (NIR, p.406). During the review, the Party explained that this issue is being considered as part of a wider wastewater improvement under the United Kingdom's GHG inventory improvement programme and that the wastewater improvement would be implemented subject to identified priorities and available resources. The ERT notes that, consistent with the 2006 IPCC Guidelines (vol.4, chap. 6, p.6.21) this issue could be resolved by using the collected information on proportions of treatment systems or expert judgment for the determination of the MCF.
W.15	5.D.2 Industrial wastewater – CH ₄ (W.20, 2017) Comparability	Review whether the notation key "NA" is correctly used for CH ₄ recovery.	Resolved. The United Kingdom used the notation key "NE" for CH ₄ recovery in CRF table 5.D. This is the appropriate notation key given that anaerobic treatment is applied and CH ₄ recovery is likely occurring, but is not estimated.
KP-LULUCF activities			
KL.1	General (KP-LULUCF activities)	Include specific information on how land under CM, GM and	Addressing. The areas of CM and GM reported under the Kyoto Protocol are broadly consistent

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	(KL.1, 2017) (KL.3, 2016) (KL.3, 2015) Transparency	WDR is identified, especially related to the report developed as part of the ongoing project on areas of WDR.	with those reported for cropland and grassland under the Convention. However, there is no information in the NIR on how these lands are identified beyond what was included in the 2017 annual submission. For WDR, the United Kingdom reported that the programme of research and methodology development based on Evans et al. (2017) is still in progress and that the Party would be in a better position to identify the areas subject to drainage and rewetting at the end of the second commitment period of the Kyoto Protocol because the publication provides maps with the location of organic soils drained and rewetted (NIR, p.474).
KL.2	General (KP-LULUCF activities) (KL.2, 2017) (KL.4, 2016) (KL.4, 2015) Accuracy	Improve the QA/QC process and correct the inconsistency in the area of land converted to forest under the Convention and the Kyoto Protocol (i.e. the area of land converted to forest in CRF table 4.1 for 2014 (12.9 kha) does not match the area of AR (reported as 10.7 kha in table NIR-2)).	Resolved. The United Kingdom resolved the inconsistencies in the areas of land converted to forest under the Convention and the Kyoto Protocol: the areas reported in CRF table 4.1 now match those reported in CRF table NIR-2 (15.12 kha in 2014). This correction suggests that the QA/QC process has been improved.
KL.3	General (KP-LULUCF activities) (KL.4, 2017) (KL.6, 2016) (KL.6, 2015) Transparency	Include information in the NIR in accordance with decision 2/CMP.8, annex II, paragraph 5(c) and (e).	Resolved. The United Kingdom provided in the NIR (pp.492–493) the information required in accordance with decision 2/CMP.8, annex II, paragraph 5(e); that is, information that demonstrates methodological consistency between the reference level and reporting for FM during the second commitment period through the application of a technical correction to the FMRL. The ERT noted that the information required in accordance with decision 2/CMP.8, annex II, paragraph 5(c) was provided already in the 2017 submission and continued to be provided in the 2019 submission (see ID# KL.22 in table 5).
KL.4	General (KP-LULUCF activities) (KL.5, 2017) (KL.16, 2016) (KL.16, 2015) Completeness	Provide estimates of emissions and removals for the Cayman Islands and Gibraltar.	Addressing. The United Kingdom is working with the Government of the Cayman Islands to obtain the AD necessary for estimating GHG emissions and removals in this overseas territory. Gibraltar has made its own LULUCF calculations and indicated that no changes in carbon stock occur in the territory, which is extremely small (6 km ²) (NIR, annexes, p.755). The ERT is of the view that the fact that the territory is small does not imply that emissions from LULUCF do not occur, and that data are necessary to support this statement. During the review, the Party informed the ERT that it would continue to explore potential sources of data and information to inform estimates of emissions and removals in the missing land areas.
KL.5	General (KP-LULUCF activities)	Revise the land areas reported in different CRF tables (in particular	Addressing. The United Kingdom resolved most of the previous inconsistencies between

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	(KL.15, 2017) Convention reporting adherence	the areas of afforestation, deforestation and CM reported in CRF table NIR-2, the areas of CM and GM reported in CRF tables NIR-2, 4(KP-I)B.2 and 4(KP-I)B.3, and the total area of the country reported in CRF table NIR-2 as well as the total land area reported under the Convention and for KP-LULUCF activities) ensuring the consistency of the reported information among CRF tables as well as between the CRF tables and the NIR, and provide a transparent explanation for any differences remaining.	the areas of afforestation and deforestation, FM, CM and GM reported in various KP-LULUCF CRF tables, and the area of the country is reported consistently under the Convention and for KP-LULUCF activities for all years except for 2014, for which a small difference can be observed (25,731.35 kha in CRF table 4.1 versus 25,731.29 kha in CRF table NIR-2). The other inconsistency that remains concerns the total area of the country reported in CRF table NIR-2: the Party reported an area of 25,731.29 kha for 2013–2014, but 25,731.35 kha for 2015–2017.
KL.6	General (KP-LULUCF activities) (KL.16, 2017) Convention reporting adherence	Report information in CRF table NIR-1 consistently with the information reported in other sectoral tables, and enhance QA/QC procedures to avoid inconsistencies in the reporting of information between CRF tables in future submissions.	Resolved. The United Kingdom reported information in CRF table NIR-1 consistently with that in other sectoral tables, including CO ₂ , CH ₄ and N ₂ O emissions from biomass burning of AR and FM land areas, suggesting that QA/QC procedures have been enhanced.
KL.7	Deforestation – CO ₂ (KL.8, 2017) (KL.9, 2016) (KL.9, 2015) Accuracy	Find a method to verify that the carbon stocks in living biomass prior to deforestation are not underestimated.	Not resolved. The United Kingdom continues to investigate what data might be available to demonstrate that underestimation of carbon stocks in living biomass is not occurring (NIR, p.467). During the review, the Party explained that this issue has no simple solution because the level of deforestation in the country is too small to be necessarily identified by the NFI surveys. The United Kingdom indicated that it would include an item in the inventory improvement plan regarding exploring the use of alternative sources of data, including satellite data, for identifying deforestation. The ERT is of the view that if deforestation occurs randomly in the country, then the use of the weighted average carbon stock to estimate changes in carbon stock from deforestation (the method currently applied by the United Kingdom) could in the long run not overestimate or underestimate the emissions. As such, if the Party could demonstrate a random distribution of deforestation, this could be one means of verifying the current approach. An alternative approach discussed during the review concerns the use of the upper limit of a 95 per cent confidence interval for the weighted average biomass. In this approach, the United Kingdom could assume a normal distribution and use the upper limit of the confidence interval to estimate the changes in carbon stock in living biomass from deforestation.

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KL.8	Deforestation – CO ₂ (KL.17, 2017) Completeness	Estimate and report carbon stock changes from deforestation in below-ground biomass, litter, deadwood and soil organic matter in the overseas territories and Crown dependencies.	Resolved. In the 2019 annual submission below-ground biomass is reported as “IE” (included with above-ground biomass), carbon stock change in litter and deadwood is reported under litter, and carbon stock change in soils is reported as “NO”, since the change in forest cover is a result of the changed areas losing sufficient tree cover to be reclassified as dense scrub or parkland, rather than conversion to settlement land or agriculture. The ERT agrees with the Party’s assessment of below-ground biomass and soils and understands that tier 1 EFs were used to estimate the changes in carbon stock in the biomass and litter pools. The United Kingdom included a misleading piece of text in the NIR (pp.471 and 756), referencing the level, which the Party confirmed will be removed in the next annual submission.
KL.9	Article 3.4 activities – CO ₂ (KL.9, 2017) (KL.10, 2016) (KL.10, 2015) Completeness	Provide estimates of the carbon stock changes in litter and deadwood for CM; litter, deadwood and organic soils for GM; and all carbon pools under WDR, and include a description of how these changes are estimated.	Addressing. The United Kingdom reported estimates of the carbon stock changes in organic soils for GM for the United Kingdom, overseas territories and Crown dependencies (CRF table 4(KP-I)B.3). For litter and deadwood for CM and GM, the Party reported “NE” in CRF table 4(KP-I)B.2 and CRF table 4(KP-I)B.3, respectively, and considers that any litter or deadwood produced by these categories will decay within a single year and will not contribute to carbon stock change within the CM or GM categories. The ERT is of the view that while this assumption may hold for GM, it may not hold for CM owing to the presence of perennial crops. Estimates for WDR for all pools were reported as “NE” in CRF table 4(KP-I)B.5, as the United Kingdom is still implementing the results of the research study of Evans et al. (2017). The Party described in the NIR how the pools are estimated or are being addressed (pp.467, 484 and 494).
KL.10	Article 3.4 activities – CO ₂ , CH ₄ and N ₂ O (KL.21, 2017) Transparency	Establish a hierarchy of elected activities under Article 3, paragraph 4; apply consistently the specified hierarchy to determine under which activity the land is to be reported in accordance with the Kyoto Protocol Supplement (section 1.2); in the cases in which a land falls into two activities, report over time that land under only one activity according to the established hierarchy; and provide detailed information in the NIR on the hierarchy and how it is consistently applied. Alternatively, in the cases of rotation of land between CM and GM, the Party	Addressing. The United Kingdom maintained CM and GM at the same level in its hierarchy of elected activities and stated that it ensured there is no double counting resulting from the methods used (NIR, p.457). The ERT is of the view that the Party can maintain the same hierarchy for CM and GM and that this approach is consistent with the Kyoto Protocol Supplement (p.1.8) if it achieves the same outcomes that the hierarchy is meant to achieve, noting that (1) Article 3, paragraph 3, activities and FM are mandatory and take precedence over elected Article 3, paragraph 4, activities; (2) once land is reported and accounted under the Kyoto Protocol, it cannot be excluded from reporting; and (3) double counting must be avoided. The ERT notes that there are implications to including CM and GM at the

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		may report all land subject to CM and GM under a single activity.	same level because the methodologies to be applied to changes in CM and GM are different. The Party documented in the NIR its efforts to avoid double counting (e.g. land undergoing rotational CM/GM will be specifically allocated to either CM or GM as a subcategory rather than regularly moving between activities; and the development of land-use vectors, which may allow the identification of areas under rotational land use and their patterns) (NIR, p.472). However, as these activities have not yet been implemented, the ERT cannot conclude that the hierarchy selected avoids double counting (see ID# KL.24 in table 5).
KL.11	FM – CO ₂ , CH ₄ and N ₂ O (KL.10, 2017) (KL.12, 2016) (KL.12, 2015) Accuracy	Correct the value of the FM cap in the CRF table “Accounting”.	Not resolved. The United Kingdom reported in the CRF table “Accounting” a value based on 3.5 per cent of the base-year emissions, as reported in the 2019 annual submission (224,293.655 kt CO ₂ eq). However, the FM cap is fixed for the second commitment period of the Kyoto Protocol, and is as contained in the report on the review of the initial report (FCCC/IRR/2016/GBR): 224,824.677 kt CO ₂ eq.
KL.12	FM – CO ₂ (KL.11, 2017) (KL.11, 2016) (KL.11, 2015) Transparency	Include information in the NIR on the main changes in the inventory leading to the technical correction of the FMRL (including the inclusion of carbon emissions and removals from forest areas afforested prior to 1921, changes in the assumptions used for the species mix, growth rates and intensity of management).	Resolved. In the 2019 annual submission, a technical correction to the FMRL was carried out to take into account adjustments to the AD and changes in FM assumptions, to better ensure consistency with wood production data, to correct double counting in the deadwood pool and to update wildfire estimates. Detailed information is provided in the NIR (pp.492–494).
KL.13	FM – CO ₂ (KL.18, 2017) Completeness	Estimate and report, in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 4), carbon stock changes in biomass from forests not used for timber production owing to biomass losses associated with harvesting and/or gathering (e.g. fuelwood) or provide transparent information justifying that such losses are not occurring.	Addressing. The United Kingdom reported that no reliable estimates are currently available on the quantity of wood removed by gathering or disturbances and hence it cannot provide estimates for the changes in carbon stock in biomass from forests not used for timber production (NIR, p.449); however, the CARBINE model provides estimates of the carbon increment of forests not used for timber production. During the review, the Party informed the ERT that the second cycle of the NFI (2015–2020) would provide additional information that is expected to allow the estimation of carbon stock changes in biomass from forests not used for timber production owing to biomass losses associated with harvesting and/or gathering.
KL.14	FM – CO ₂ (KL.19, 2017) Comparability	Report separately carbon stock changes for above-ground and below-ground biomass.	Addressing. For the United Kingdom mainland, the Party was able to report carbon stock changes from below-ground biomass separately from above-ground biomass in CRF table 4(KP-I)B.1 as a result of improvements made to the CARBINE model. For the overseas

<i>ID#</i>	<i>Issue and/or problem classification^{a, b}</i>	<i>Recommendation made in previous review report</i>	<i>ERT assessment and rationale</i>
			territories and Crown dependencies, carbon stock changes from below- and above-ground biomass were reported together. During the review, the United Kingdom indicated that it would apply default root-to-shoot values from the 2006 IPCC Guidelines in order to report the carbon stock changes in above- and below-ground biomass separately for overseas territories and Crown dependencies.
KL.15	FM – CO ₂ (KL.20, 2017) Accuracy	<p>(a) Estimate the background level and margin using a consistent and initially complete time series containing emissions for the period 1990–2009, in accordance with decision 2/CMP.7, annex, paragraph 33, using, if appropriate, methodologies from the 2006 IPCC Guidelines (e.g. vol. 1, chap. 5);</p> <p>(b) Report in the NIR detailed information on the background level of emissions associated with annual natural disturbances that have been included in the FMRL, on how the background levels and margins for AR and FM have been estimated, on how the Party avoids the expectation of net credits or net debits during the commitment period, and on how the FMRL technical correction addresses emissions from natural disturbances for which the provision (e.g. substitution of natural disturbances emissions in the FMRL by the background level estimated) is intended to be applied;</p> <p>(c) Report the background level and margin estimated for AR and FM in CRF tables 4(KP-I)A.1.1 and 4(KP-I)B.1.3.</p>	<p>(a) Not resolved. The United Kingdom did not provide in the NIR information additional to that reported in its initial report or in the previous annual submission. According to the NIR (p.456), complete data for the period 1990–2009 do not exist;</p> <p>(b) Not resolved. The United Kingdom did not provide in the NIR information additional to that reported in its initial report or in the previous annual submission;</p> <p>(c) Not resolved. The United Kingdom did not report in CRF tables 4(KP-I)A.1.1 and 4(KP-I)B.1.3 the background level and margin for AR (reported as “NA”) or for FM (reported as “NO”).</p>
KL.16	FM – CO ₂ (KL.20, 2017) Transparency	Provide detailed information on any recalculations performed in the time series of emissions from natural disturbance types for which the natural disturbances provision is intended to be applied.	Resolved. The United Kingdom did not perform any recalculations in the time series of emissions from natural disturbance types and maintained the same emissions as those in its initial report for estimating the background level and the margin for AR and FM.
KL.17	GM – CO ₂ (KL.22, 2017) Consistency	Define the category of land under which hedges are to be accounted, ensure that corresponding GHG emissions and removals are estimated, and report consistently thereon for the entire time series.	Addressing. The United Kingdom noted that hedgerows (which fall within the settlements category) would be allocated consistently to the grassland category in the next submission (NIR, p.357). During the review, the Party explained that net emissions from hedgerows are all allocated to the grassland category, and amounted to –8.88 Gg C in 2017. The small area of hedgerows that occurs within settlements (7 per cent of 120 kha, or 8.41 kha,

<i>ID#</i>	<i>Issue and/or problem classification^{a, b}</i>	<i>Recommendation made in previous review report</i>	<i>ERT assessment and rationale</i>
			in 2017) was still reported under settlements in the 2019 submission but represents only a very small fraction of settlement (and grassland) area. In addition, the net emissions from these hedges (–0.60 kt C in 2017) are small compared with the net biomass carbon stock change in land converted to settlements (–69.65 kt C in 2017).
KL.18	GM – CO ₂ (KL.23, 2017) Convention reporting adherence	Report the same area of organic soils in grassland and GM in the United Kingdom (excluding overseas territories and Crown dependencies) in CRF tables 4(II) and 4(KP-I)B.3, respectively.	Resolved. The area of organic soils in CRF tables 4(II) and 4(KP-I)B.3 for mainland United Kingdom is the same (192.87 kha in 2017).
KL.19	GM – CO ₂ , CH ₄ and N ₂ O (KL.24, 2017) Completeness	Develop the necessary AD on controlled burning throughout the year and in land areas smaller than 1 ha, and estimate and report the associated CO ₂ and non-CO ₂ emissions for the entire territory.	Not resolved. The improvements recommended have not yet been implemented. However, the United Kingdom has identified potential data sources that may allow the estimation of emissions from controlled burning throughout the year and on lands smaller than 1 ha in future submissions.
KL.20	WDR – CO ₂ , CH ₄ and N ₂ O (KL.25, 2017) Completeness	(a) Report the timetable for the ongoing project to incorporate WDR into the annual submission, including when the final results will be available for use in estimating CO ₂ and non-CO ₂ emissions from lands in the entire territory subject to WDR; (b) Follow, until the final results from the project are available, an interim approach (using alternative data sources) to obtain the necessary AD and use appropriate methodologies from the Wetlands Supplement to estimate CO ₂ and non-CO ₂ emissions for all the carbon pools from lands in the entire territory subject to WDR, noting the provisions of decision 2/CMP.7, annex, paragraph 26, decision 2/CMP.8, annex II, paragraph 2(a), (d) and (e), and decision 6/CMP.9, paragraph 10; (c) Report CO ₂ and non-CO ₂ emissions in CRF tables 4(KP-I)B.5, 4(KP-II)1, 4(KP-II)2 and 4(KP-II)4, and explain in the NIR how they have been estimated.	(a) Not resolved. No specific timetable has been provided. The United Kingdom reported that the results of the project are currently under review for implementation in the annual submission and preliminary results show significant uncertainty in the areas assigned to different management actions around drainage and rewetting (NIR, p.458). Further work to improve the understanding of the areas of peatland in different conditions of implied drainage and rewetting is being considered. During the review, the Party indicated that it intends to incorporate WDR by the 2022 annual submission at the latest, and highlighted its progress in this regard (see the box on p.361 in the NIR); (b) Not resolved. The United Kingdom reported that at present there is insufficient information to allow the estimation of CO ₂ and non-CO ₂ emissions from drained and rewetted soils under CM, GM and WDR activities (NIR, p.460). The use of a tier 1 approach would require AD (area of organic soils subject to drainage and rewetting) that are not presently available; (c) Not resolved. The United Kingdom reported CO ₂ and non-CO ₂ emissions for WDR in CRF tables 4(KP-I)B.5, 4(KP-II)1, 4(KP-II)2 and 4(KP-II)4 using the notation key “NE”.
KL.21	HWP – CO ₂ (KL.26, 2017) Accuracy	Estimate the HWP contribution for HWP from deforestation on the basis of instantaneous oxidation.	Resolved. Carbon stock changes in the HWP pool (CRF table 4(KP-I)C) were calculated on a FOD function basis for AR and FM areas and on an instantaneous oxidation basis for deforestation areas, in accordance with the Kyoto Protocol Supplement. The United

<i>ID#</i>	<i>Issue and/or problem classification^{a, b}</i>	<i>Recommendation made in previous review report</i>	<i>ERT assessment and rationale</i>
			Kingdom reported that all HWP from deforestation are assumed to be instantaneously oxidized (NIR, annexes, p.742).

^a References in parentheses are to the paragraph(s) and the year(s) of the previous review report(s) in which the issue and/or problem was raised. Issues are identified in accordance with paras. 80–83 of the UNFCCC review guidelines and classified as per para. 81 of the same guidelines. Problems are identified and classified as problems of transparency, accuracy, consistency, completeness or comparability in accordance with para. 69 of the Article 8 review guidelines in conjunction with decision 4/CMP.11.

^b The report on the review of the 2018 annual submission of the United Kingdom was not available at the time of the 2019 review. Therefore, the previous recommendations reflected in table 3 are taken from the 2017 annual review report. For the same reason, 2018 is excluded from the list of review years in which the issue could have been identified.

IV. Issues identified in three successive reviews and not addressed by the Party

9. In accordance with paragraph 83 of the UNFCCC review guidelines, the ERT noted that the issues included in table 4 have been identified in three successive reviews, including the review of the 2019 annual submission of the United Kingdom, and have not been addressed by the Party.

Table 4

Issues and/or problems identified in three successive reviews and not addressed by the United Kingdom of Great Britain and Northern Ireland

<i>ID#</i>	<i>Previous recommendation for the issue identified</i>	<i>Number of successive reviews issue not addressed^a</i>
General		
G.1	Improve the transparency of the NIR by including sufficient information in the annual submission	4 (2014–2019)
G.2	When preparing the NIR, compare the 90 per cent of assigned amount value against the total GHG emissions, excluding LULUCF, in the most recent year	3 (2015/2016–2019)
G.4	Address the transparency issues identified in the previous review reports	3 (2015/2016–2019)
G.5	Strengthen the national system in order to ensure the completeness of the coverage of the LULUCF and KP-LULUCF estimates of emissions and removals, and report on improvements made in the NIR	3 (2015/2016–2019)
Energy		
E.1	Clearly indicate the geographical coverage of DUKES and demonstrate how fuel consumption data at the subcategory level for each overseas territory and Crown dependency are obtained and incorporated into the national totals for that subcategory	3 (2015/2016–2019)
IPPU		
	No issues identified	
Agriculture		
	No issues identified	
LULUCF		
L.1	Report mineral and organic soils separately under cropland and grassland	3 (2015/2016–2019)
L.2	Assess the use of notation keys for the reporting of organic cropland and grassland soils, as appropriate	3 (2015/2016–2019)

<i>ID#</i>	<i>Previous recommendation for the issue identified</i>	<i>Number of successive reviews issue not addressed^a</i>
L.6	Provide estimates of emissions and removals for the missing land areas (Bermuda, Cayman Islands, Gibraltar and Montserrat)	3 (2015/2016–2019)
L.12	Include information in the NIR on the verification of all carbon stock changes estimated using tier 3 methods and/or models (CARBINE, C-Flow and BSORT models)	3 (2015/2016–2019)
L.29	Include verifiable production data from the CARBINE model and the corresponding factors used to convert the production data to carbon, and report those data in CRF table 4.Gs2 to enable a more thorough verification of the HWP estimates	3 (2015/2016–2019)
Waste		
W.1	Implement the proposed improvements of the emission estimates for solid waste disposal sites in the overseas territories and Crown dependencies by providing further information on the methodologies used to estimate the emissions and by completing the CRF tables with specific parameters such as AD, MCF and DOC	5 (2013–2019)
W.2	Include in the NIR information on the parameters used in the MELMod model, including the exact figures and background information on their origin or method of derivation, and a weblink to the report on the review of landfill CH ₄ emissions modelling	3 (2015/2016–2019)
W.13	Report on any progress in collecting the data needed to report AD and emissions from industrial wastewater separately from domestic wastewater	3 (2015/2016–2019)
KP-LULUCF activities		
KL.1	Include specific information on how land under CM, GM and WDR is identified, especially related to the report developed as part of the ongoing project on areas of WDR	3 (2015/2016–2019)
KL.4	Provide estimates of emissions and removals for the Cayman Islands and Gibraltar	3 (2015/2016–2019)
KL.7	Find a method to verify that the carbon stocks in living biomass prior to deforestation are not underestimated	3 (2015/2016–2019)
KL.9	Provide estimates of the carbon stock changes in litter and deadwood for CM; litter, deadwood and organic soils for GM; and all carbon pools under WDR, and include a description of how these changes are estimated	3 (2015/2016–2019)
KL.11	Correct the value of the FM cap in the CRF table “Accounting”	3 (2015/2016–2019)

^a The report on the review of the 2018 annual submission of the United Kingdom has not yet been published. Therefore, 2018 was not included when counting the number of successive years in table 4. As the reviews of the Party's 2015 and 2016 annual submissions were conducted together, they are not considered successive and 2015/2016 is considered as one year.

V. Additional findings made during the individual review of the 2019 annual submission

10. Table 5 contains findings made by the ERT during the individual review of the 2019 annual submission of the United Kingdom that are additional to those identified in table 3.

Table 5

Additional findings made during the individual review of the 2019 annual submission of the United Kingdom of Great Britain and Northern Ireland

<i>ID#</i>	<i>Finding classification</i>	<i>Description of the finding with recommendation or encouragement</i>	<i>Is finding an issue and/or a problem?^a</i>
General			
G.9	Key category analysis	<p>The ERT noted that while the United Kingdom implemented a key category analysis following Approach 1 for its submission under the Convention, reporting the results in the NIR (annex I), an analysis was not conducted for the data submitted under the Kyoto Protocol. During the review, the ERT asked the Party whether it expected the list of key categories to change significantly if a key category analysis were implemented for data submitted under the Kyoto Protocol. The United Kingdom replied that it would expect no changes to the key categories because of the small differences in the figures between the submissions under the Convention and the Kyoto Protocol. For example, for 2017, the total national emissions reported under the Convention were 474,346.12 kt CO₂ eq excluding LULUCF and 464,453.44 kt CO₂ eq including LULUCF, while the corresponding emissions reported under the Kyoto Protocol were 473,569.77 and 463,677.09 kt CO₂ eq.</p> <p>The ERT recommends that the United Kingdom conduct a key category analysis, following at least Approach 1, for the sources and sinks of the territory reported under the Kyoto Protocol.</p>	Yes. Convention reporting adherence
G.10	NIR	<p>The ERT noted that the sectoral chapters of the NIR do not include the results of the uncertainty analysis at the category level for most categories, but rather refer to annex 2 to the NIR for this information (e.g. railways (p.174), nitric acid (p.235), enteric fermentation (p.309) and waste incineration (p.393)). The ERT acknowledges that the values of and rationales for determining the uncertainties of AD and EFs applied are sufficiently described in annex 2, but considers that providing a summary of the uncertainty assessment for each category in the respective section of the body of the NIR would improve its readability.</p> <p>The ERT encourages the United Kingdom to include a brief description of the uncertainty associated with each category in the “Uncertainties and time series consistency” section under each category in the NIR. A brief sentence, as currently appears in these sections under the LULUCF sector, or a summary table, as is currently included in the overview descriptions of the energy and LULUCF sectors, would suffice.</p>	Not an issue/problem
G.11	Other	<p>The ERT noted that in several sections of the NIR, the United Kingdom provided the explanation that emissions and removals from overseas territories and Crown dependencies have not been included because they are below the level of significance (see ID#s A.1, L.28 and KL.8 in table 3). In addition, in the energy sector, emissions from shale gas exploration are claimed to be insignificant and so are not included in the inventory (see ID# E.21 in table 3). The ERT considers that the Party does not always use the significance threshold in an appropriate way: the threshold cannot be used when the omissions are part of a category for which estimates have been provided in the annual submission. Further, the ERT finds that the Party has not made an overall assessment in its NIR to demonstrate that the total emissions excluded from reporting owing to insignificance remain below 0.1 per cent of total national emissions, as required by paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.</p> <p>The ERT, noting the recommendations already contained in ID#s E.21, A.1, and L.28 in table 3, recommends that the United Kingdom improve the transparency of its reporting regarding completeness by including in the NIR a table or other form of appropriate documentation summarizing the categories determined to be insignificant and the level of assumed emissions for each of those categories; the table or other form of documentation may include a</p>	Yes. Transparency

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
G.12	Uncertainty analysis	<p>reference to the value of the threshold of 0.05 per cent of the total CO₂ eq, excluding LULUCF, each category should be compared with, and the value of the threshold of 0.1 per cent of total CO₂ eq, excluding LULUCF, to ensure that the sum of missing categories excluded does not exceed this threshold.</p> <p>The ERT noted that uncertainty analyses following Approach 1 and Approach 2 were conducted for data submitted under the Convention but not under the Kyoto Protocol (see ID# G.9 above regarding a similar issue but for the conduct of the key category analysis). During the review, the United Kingdom explained that, similar to the case with the key category analysis, it would not expect changes in the results of the uncertainty analysis if it were to include the territory under the Kyoto Protocol.</p> <p>The ERT recommends that the United Kingdom conduct an uncertainty analysis, following at least Approach 1, for the territory reported under the Kyoto Protocol.</p>	Yes. Convention reporting adherence
G.13	Uncertainty analysis	<p>The ERT noted that the uncertainty analyses have not always been conducted at the appropriate category level, as specified in the UNFCCC Annex I inventory reporting guidelines. For instance, for the IPPU sector, the United Kingdom estimated the uncertainty for CO₂ emissions at the level of category 2.B (chemical industry) and not at the level of the subcategories under it (e.g. 2.B.1 (ammonia production)) as suggested by paragraph 15 of the UNFCCC Annex I inventory reporting guidelines. As the results of the uncertainty analysis are used for the Approach 2 key category analysis, the disaggregation of the former analysis affects the latter analysis.</p> <p>The ERT recommends that the United Kingdom conduct uncertainty analyses, following at least Approach 1, at the appropriate level of category disaggregation in accordance with paragraph 15 of the UNFCCC Annex I inventory reporting guidelines.</p>	Yes. Convention reporting adherence
Energy			
E.22	1. General (energy sector) – all fuels – CO ₂ , CH ₄ and N ₂ O	<p>The ERT welcomes the use of facility-level data by the United Kingdom to estimate GHG emissions from several categories in the energy sector (see ID#s E.13, E.15 and E.18 in table 3). Nevertheless, the United Kingdom acknowledged during the review, and the ERT agreed, that there are opportunities to expand the collection to obtain more data of benefit to the inventory. For example, while noting that fugitive CO₂ and CH₄ emissions from petroleum systems are not key categories in the United Kingdom, data already available at offshore oil and gas wells could be collected at a more disaggregated level (e.g. process, fugitive, flaring, venting, loading), making it possible to report these more disaggregated data in the CRF.</p> <p>The ERT encourages the United Kingdom to continue its efforts to obtain additional and/or improved facility-reported data for all energy sector categories, collected at a level of disaggregation and coverage that will allow their seamless integration with national energy data (in the case where the facility-level data do not represent the entire category) and consistent use in the inventory.</p>	Not an issue/problem
E.23	1.A Fuel combustion – sectoral approach – all fuels – CO ₂ , CH ₄ and N ₂ O	<p>The ERT noted that in some cases the United Kingdom used IPCC default EFs even though EFs derived from data reported under the EU ETS were available for the emissions source (e.g. CO₂ EFs for refinery fuel gas used in upstream oil and gas extraction facilities and gas separation plants). During the review, the Party explained that it sometimes uses different EFs to disaggregate combustion-related CO₂ emissions from the same fuel (e.g. LPG or refinery fuel gas) to different subcategories of the upstream oil and gas industry. Some of the EFs used for minor fuels (e.g. ethane) are IPCC default values.</p>	Not an issue/problem

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
E.24	1.A.1.c Manufacture of solid fuels and other energy industries – refinery gas – CO ₂	<p>Given this background, and the fact that facility-reported data are available, the ERT encourages the United Kingdom to use up-to-date country-specific EFs to disaggregate fuels, incorporating consistent facility-level EU ETS data, where possible.</p> <p>The ERT noted that the United Kingdom’s refinery gas CO₂ combustion EF (which is only used in conjunction with consumption at gas separation plants) is referenced as the EF for ethane contained in the 2006 IPCC Guidelines (NIR, p.137). The EF actually used by the Party (66.90 t/TJ), however, has a slightly different value than that of the ethane EF in the 2006 IPCC Guidelines (vol. 2, table 2.2) (61.60 t/TJ). During the review, the Party explained that the units for this EF had been inadvertently converted using the higher heating value (i.e. gross calorific value), rather than the lower heating value (i.e. net calorific value). The ERT noted that this is not an accuracy issue, as this EF is used only for allocating emissions reported by facilities (i.e. the EF is used to estimate emissions for gas separation plants, but the total emissions for category 1.A.1.c.ii (oil and gas extraction) are obtained from the reported operator CO₂ emissions). Therefore, the total CO₂ eq emissions reported in the annual submission are not affected. This issue does, however, lead to a slight misallocation of CO₂ emissions from refinery fuel gas by subindustry within the category. Furthermore, the description of the use of the EF is not clear in the NIR (e.g. the reference on p.137 does not describe which EF from the 2006 IPCC Guidelines has been applied).</p> <p>The ERT recommends that the United Kingdom ensure that it applies the lower net calorific value when inputting information in its models in order to estimate refinery gas emissions and clarify in the NIR the description of the methodology used and source of the CO₂ EF.</p>	Yes. Transparency
E.25	1.A.3.e.ii Other (other transportation) – liquid and gaseous fuels – CO ₂ , CH ₄ and N ₂ O	<p>The ERT noted that potentially outdated technology data are being used in the United Kingdom’s off-road estimates. During the review, the Party provided the ERT with a description of the model it uses to evaluate emissions from off-road mobile equipment. It is a detailed model that estimates emissions from more than 70 types of (mostly diesel) equipment used throughout the country. The AD for these estimates are obtained from the DUKES energy balance. The CO₂ EFs for diesel oil in off-road vehicles are taken from the United Kingdom carbon factors review in 2004 (Netcen, 2004), which the Party believes to be an accurate reflection of circumstances in the United Kingdom. The ERT noted that although the model is advanced, it was last updated in 2004 and therefore the equipment data used in it are slowly becoming outdated, to which the Party responded that it hoped to update the model within the next one–two years. The ERT considers that the use of equipment data from 2004 likely does not reflect current circumstances in the country.</p> <p>The ERT recommends that the United Kingdom evaluate the relevance of the current equipment data used in the 2004 model for estimating off-road emissions, and on the basis of the results of the evaluation, either document in the NIR how the model still reflects current circumstances or make efforts to update the model and report on progress in the NIR.</p>	Yes. Accuracy
E.26	1.B.2 Oil, natural gas and other emissions from energy production – liquid and gaseous fuels – CO ₂ and CH ₄	<p>The ERT noted that the Elgin offshore rig blowout occurred in March 2012 (see, e.g., Gosden, 2012). The ERT also noted that no information on the estimation of CO₂ and CH₄ emissions from the blowout was provided in the NIR, although the United Kingdom mentioned that no data are currently available with which to estimate emissions from oil and gas well blowouts (p.200). During the review, the Party indicated that the relevant authorities had just (during the review week) released a report containing information on emissions related to the blowout. The ERT believes</p>	Not an issue/problem

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
IPPU		<p>that future ERTs should consider this issue further to ensure that emissions from this category are not underestimated.</p> <p>The ERT encourages the United Kingdom to obtain the environmental report and emission data for the Elgin offshore rig blowout, and, after appropriate evaluation, incorporate the data into the annual submission. The ERT also encourages the Party to investigate whether emissions from other oil and gas well blowouts are occurring in the country and, if data on the amount of fuel lost during the blowout exist, to estimate the emissions and update the NIR to include the AD, EFs and methodology, including sources of data used, for estimating all emissions from oil and gas well blowouts. If only the amount of fuel lost during a blowout is available, that amount could be considered as a rough approximation of AD and used with a tier 1 EF for venting. Blowout fugitive emissions calculated in this manner would have a high degree of uncertainty but would represent an improvement over not estimating this category.</p>	
I.14	2. General (IPPU)	<p>The ERT identified several errors in the NIR that individually and collectively impacted its transparency, in particular that of the descriptions of several categories. During the review, the ERT discussed the individual issues with the United Kingdom, which acknowledged the errors and the lack of transparency in reporting on the IPPU sector they create. The ERT concludes that as a result of these issues, the description of several categories in the NIR lack transparency.</p> <p>The ERT recommends that the United Kingdom improve the transparency of its reporting by correcting in the NIR the following issues:</p> <p>(a) For category 2.A.1 (cement production), include in NIR figure 4.1 the year for which the data are presented, use the correct units for data in NIR figure 4.2 (data are presented as CO₂ emissions, not as carbon emissions), clarify that the data provided in NIR table 4.3 are IEFs not EFs, and define the abbreviation “CEF” in NIR table 4.3;</p> <p>(b) For category 2.A.2 (lime production), identify in NIR table 4.1 the correct tiers applied for estimating CO₂ emissions (i.e. tier 1 for 1990–1993 and tier 3 from 1994 onward);</p> <p>(c) In NIR table 4.4, change the units of the EF applied for CO₂ emissions from lime production from kt C/kt carbonate to t C/kt carbonate;</p> <p>(d) On page 224 of the NIR, update the text regarding the year in which FGD systems were introduced in the United Kingdom to clarify that CO₂ emissions from FGD systems have been reported since 1994, consistent with CO₂ emissions from category 2.A.4 (other process uses of carbonates) reported in CRF table 2(I)A-Hs1;</p> <p>(e) On page 239 of the NIR, correct the information stating that emissions from soda ash used in the manufacture of soda lime glasses are reported under category 2.A.4 (other process uses of carbonates) to clarify that these emissions are in fact reported under category 2.A.3 (glass production);</p> <p>(f) On page 236 of the NIR, correct the information stating that N₂O emissions from nitric acid production and adipic acid production were reported together for the years 1990–1994 under category 2.B.3 (adipic acid production) to clarify that these emissions have been reported separately for the entire time series in CRF table 2(I)s1;</p>	Yes. Transparency

<i>ID#</i>	<i>Finding classification</i>	<i>Description of the finding with recommendation or encouragement</i>	<i>Is finding an issue and/or a problem?^a</i>
		(g) On page 238 of the NIR, correct the name of category 2.B.7 so that it reads soda ash production, instead of soda ash production and use, which is consistent with the title in CRF table 2(I).A-Hs1 and with the corresponding data reported by the Party in that table.	
I.15	2.A.2 Lime production – CO ₂	<p>According to the NIR (p.219), the EU ETS data for United Kingdom sugar producers do not include any emissions from calcination, and consultation with the industry in the past confirmed that the industry considers there to be no CO₂ emissions from this activity. However, based on a recommendation in a previous review report (FCCC/ARR/2013/GBR, paras. 47–48), the United Kingdom included a default percentage of unreacted lime in its calculations. The ERT noted that, according to the information provided by the Party during the review, CO₂ emissions from lime production at sugar plants were estimated on the basis of an assumption that 24 per cent of the lime is not recarbonated after use in the process of sugar production. The ERT also noted that section 4.3.2 of the NIR does not contain details on the methodology used for estimating CO₂ emissions from sugar plants. The ERT acknowledges that the methodology for estimating emissions from sugar refining was assessed in 2013 and that the approach is consistent with the 2006 IPCC Guidelines, however concludes that the methodological description in the NIR is not transparent.</p> <p>The ERT recommends that the United Kingdom include in the NIR a more detailed description of the methodology used for estimating CO₂ emissions from lime production at sugar plants, including documenting the assumption that 24 per cent of lime produced at sugar plants is not recarbonated.</p>	Yes. Transparency
I.16	2.A.2 Lime production – CO ₂	<p>The ERT noted that according to CRF table 2(I).A-Hs1, the AD for lime production are “limestone used for lime production”; however, according to the NIR, the AD include a mix of limestone and dolomite (p.219). During the review, the United Kingdom confirmed that the AD used for estimating CO₂ emissions from lime production include both limestone and dolomite and agreed to change the AD identified in CRF table 2(I).A-Hs1 in the next submission. The ERT concludes that information on the AD for category 2.A.2 is not transparent.</p> <p>The ERT recommends that the United Kingdom clarify in the description of the AD for category 2.A.2 in CRF table 2(I).A-Hs1 that both limestone and dolomite are used for lime production.</p>	Yes. Transparency
I.17	2.A.4 Other process uses of carbonates – CO ₂	<p>The ERT noted that CO₂ emissions from stone wool production were reported under category 2.A.3 (glass production), which is not in compliance with the 2006 IPCC Guidelines: these emissions should be reported under subcategory 2.A.4.d (other). During the review, the United Kingdom agreed that CO₂ emissions were incorrectly allocated. The Party stated that the reporting of CO₂ emissions from stone wool production is difficult without disclosing confidential data from EU ETS reports. The ERT concludes that the Party’s reporting of CO₂ emissions from stone wool production is not comparable with that of other Parties.</p> <p>The ERT recommends that the United Kingdom report CO₂ emissions from stone wool production under subcategory 2.A.4.d (other) along with emissions from other sources currently reported under that category to avoid disclosing confidential data, or, if the number of facilities reporting under that category is insufficient to enable the confidential data from stone wool producers to be masked, report them at an aggregated level under one of the other categories under the mineral industry and use the appropriate notation key under category 2.A.4.d, if needed, providing a relevant explanation in the NIR as to where emissions are reported.</p>	Yes. Comparability

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
I.18	2.A.4 Other process uses of carbonates – CO ₂	<p>The ERT noted that CO₂ emissions from limestone use for FGD systems used at energy plants are reported under subcategory 2.A.4.d (other) when, according to the 2006 IPCC Guidelines, CO₂ emissions from limestone use should be reported under the category in which the carbonates are consumed (vol. 3, section 2.5.1). During the review, the United Kingdom explained that it is not clear how FGD emissions could be reported under the energy sector in the CRF tables in a transparent manner. The ERT concludes that CO₂ emissions from FGD systems are not reported in a manner that is comparable with other Parties' reporting.</p> <p>The ERT recommends that the United Kingdom report CO₂ emissions from limestone use for FGD systems used at energy plants in the country under category 1.B.2.d (other (oil, natural gas and other emissions from energy production)).</p>	Yes. Comparability
I.19	2.A.4 Other process uses of carbonates – CO ₂	<p>The ERT noted that according to the ongoing (unpublished) study on the non-glass uses of soda ash undertaken by Ricardo Energy and Environment provided to the ERT during the review, CO₂ emissions from the use of sodium bicarbonate in the United Kingdom amounted to 35.9 kt CO₂ in 2017. The Party explained that these emissions were not reported in the 2019 annual submission because the study has not been completed. The ERT concludes that although the inventory is not complete because CO₂ emissions from sodium bicarbonate use were not reported, the estimated emissions are below the threshold of significance for the United Kingdom (237 kt CO₂ eq in 2017) and therefore below the threshold for inclusion of this issue in the list of potential problems and further questions raised by the ERT in accordance with decision 22/CMP.1 in conjunction with decision 4/CMP.11, annex, paragraph 80(b).</p> <p>The ERT recommends that the United Kingdom complete the ongoing study on the non-glass uses of soda ash in the country, and estimate and report CO₂ emissions from sodium bicarbonate use under subcategory 2.A.4.d (other) as well as update the NIR to include the relevant AD, EF and methods used for estimating these emissions.</p>	Yes. Completeness
I.20	2.A.4 Other process uses of carbonates – CO ₂	<p>The ERT noted that under subcategory 2.A.4.a (ceramics), only CO₂ emissions from brick production were reported. However, according to the NIR, other types of ceramics are also produced in the United Kingdom (e.g. wall and floor tiles, refractories, sanitary ware, household ceramics) (pp.227–228). Data provided in NIR table 4.7 for the period 2008–2012 show that clay consumption for ceramic products other than bricks (0.43 Mt) amounted to 11 per cent of the clay consumption for brick production (3.93 Mt). The ERT estimated that if the share of clay consumption for ceramic products other than bricks was the same in 2017 as in the period 2008–2012, emissions from these other ceramic products would be about 28 kt CO₂ eq. The ERT noted that AD for clay consumption for bricks, pipes and tiles are available in the <i>United Kingdom Minerals Yearbook</i>. During the review, the availability of AD and possible methods for estimating CO₂ emissions from ceramics other than bricks were discussed with the United Kingdom, and the Party agreed with the following assessment of the ERT. The ERT concludes that although CO₂ emissions from subcategory 2.A.4.a are not complete, the estimated emissions are below the threshold of significance for the United Kingdom (237 kt CO₂ eq in 2017) and therefore below the threshold for inclusion of this issue in the list of potential problems and further questions raised by the ERT in accordance with decision 22/CMP.1 in conjunction with decision 4/CMP.11, annex, paragraph 80(b).</p> <p>The ERT recommends that the United Kingdom estimate CO₂ emissions from ceramic products other than bricks either by using the assumption that the clay consumption of these products is on average 11 per cent of the clay consumption of brick production, according to the available data for the period 2008–2012, or by applying a</p>	Yes. Completeness

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
I.21	2.B Chemical industry – CO ₂	<p>country-specific method (e.g. based on the AD for clay consumption for different applications as provided in the <i>United Kingdom Minerals Yearbook</i>), and report these emissions under subcategory 2.A.4.a (ceramics).</p> <p>The ERT noted that CO₂ emissions from several categories under category 2.B (chemical industry) were reported as constant for several years in the time series: 2.B.6 (titanium dioxide production) in 1990–1998 (104.63 kt CO₂), 2.B.7 (soda ash production) in 1990–1998 (231.55 kt CO₂), 2.B.8.a (petrochemical and carbon black production – methanol) in 1990–1997 (497.72 kt CO₂), 2.B.8.d (petrochemical and carbon black production – ethylene oxide) in 1990–1995 (131.00 kt CO₂) and 2.B.8.f (petrochemical and carbon black production – carbon black) in 1990–1998 (437.15 kt CO₂). During the review, the United Kingdom explained that the emission data or AD were not available for several categories of 2.B for early years of the time series. The Party therefore used the available average value of emissions for categories 2.B.6, 2.B.7 and 2.B.8.d and the maximum capacity of chemical installations for categories 2.B.8.a and 2.B.8.f to fill the gaps of AD and emissions in the time series. The ERT notes that the method used to determine emissions for periods where AD or emission data were not available does not correspond to the methods for ensuring time-series consistency in the 2006 IPCC Guidelines (vol. 1, chap. 5). The ERT concludes that the time series of emissions is not consistent for categories 2.B.6, 2.B.7, 2.B.8.a, 2.B.8.d and 2.B.8.f.</p> <p>The ERT recommends that the United Kingdom use the standard splicing techniques in the 2006 IPCC Guidelines (vol. 1, sections 5.5.3.1–5.5.3.4) to fill the gaps of AD and CO₂ emissions for categories 2.B.6 (titanium dioxide production) in 1990–1998, 2.B.7 (soda ash production) in 1990–1998, 2.B.8.a (petrochemical and carbon black production – methanol) in 1990–1997, 2.B.8.d (petrochemical and carbon black production – ethylene oxide) in 1990–1995 and 2.B.8.f (petrochemical and carbon black production – carbon black) in 1990–1998, revise the CO₂ emission estimates accordingly, and explain in the NIR which techniques were used to fill the gaps (e.g. the ERT considers that the surrogate data or overlap approach may be appropriate for developing a consistent time series). If the Party is not able to apply the standard splicing techniques, the ERT recommends that the United Kingdom follow the 2006 IPCC Guidelines (vol. 1, sections 5.3.3.5–5.3.3.6) and apply an alternative technique for splicing, providing an explanation in the NIR as to why the standard techniques are not valid, documenting the alternative technique applied and comparing the results with one of the standard techniques contained in the 2006 IPCC Guidelines. The ERT notes that, taking into account the Party's concerns about the significant efforts to resolve the issue, expressed in response to a draft version of this report, and in line with paragraph 73 of the UNFCCC Annex I inventory review guidelines, the Party could include in the NIR information on the amount of effort and resources required for this improvement relative to the impact of revised emission estimates for categories 2.B.6, 2.B.7, 2.B.8.a, 2.B.8.d and 2.B.8.f on the level and/or trend of total national GHG emissions and demonstrate that the change of the total national GHG emissions will be insignificant.</p>	Yes. Consistency
I.22	2.B.1 Ammonia production – CH ₄ and N ₂ O	<p>The ERT noted that in CRF table 2(I).A-Hs1, CH₄ (0.01 kt in 2017) and N₂O (0.001 kt in 2017) emissions from ammonia production were reported under category 2.B.1. However, in the NIR, CH₄ emissions from ammonia production were reported under category 2.B.10 (other (chemical industry)) (pp.229 and 245). During the review, the United Kingdom explained that category 2.B.10 aggregates emissions across many chemical production sites, including those that produce ammonia within fertilizer production complexes, for which source-specific data on CH₄ and N₂O emissions are not available (emissions represent totals across the installation). The Party also explained that IPCC default CH₄ and N₂O EFs were applied to the combustion component of natural gas use in ammonia production, and these emissions were reported under category 2.B.1. The Party considers that the chosen approach</p>	Yes. Accuracy

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
		<p>ensures completeness but may result in a small amount of double counting, totalling 614 t CO₂ eq in 2017, which is 0.0001 per cent of the United Kingdom's total national GHG emissions, excluding LULUCF. The ERT concludes that the description of CH₄ and N₂O emissions in the NIR is not transparent and that the total CH₄ and N₂O emissions may not be accurately reported.</p> <p>The ERT recommends that the United Kingdom either avoid the double counting between categories 2.B.1 and 2.B.10 (other (chemical industry)) or explain in the NIR that double counting of the emissions may occur between these categories. The ERT also recommends that the Party provide in the NIR a description of the methodology used for estimating CH₄ and N₂O emissions from ammonia production reported under category 2.B.1 and provide the correct reference (i.e. to category 2.B.1 instead of 2.B.10) in CRF table 2(I).A-Hs1, where these emissions are reported.</p>	
I.23	2.B.8 Petrochemical and carbon black production – CO ₂	<p>According to page 240 of the NIR, category 2.B.8.g was identified as “2.B.8.g chemicals: OPG” (referring to other petroleum gases). However, according to CRF table 2(I).A-Hs1, the correct name of the category is “2.B.8.g Other”. The ERT noted that emissions reported under the latter category in CRF table 2(I).A-Hs1 were not specified and were reported under the row “Other (please specify)”. During the review, the United Kingdom explained that the name of category 2.B.8.g in the NIR was changed to reflect the emissions reported under the category. The ERT concludes that the description of category 2.B.8.g is not transparent in the NIR because it does not use a naming convention consistent with that of the CRF tables. Further, the ERT concludes that the description in CRF table 2(I).A-Hs1 is not transparent because emissions reported under 2.B.8.g other were not specified.</p> <p>The ERT recommends that the United Kingdom specify in CRF table 2(I).A-Hs1 that CO₂ emissions from “OPG” are reported under subcategory 2.B.8.g (other) by changing the category description from “Other (please specify)” to “Other petroleum gases (OPG)”. The ERT also encourages the Party to use the name of the category, 2.B.8.g (other), in the NIR, corresponding to the name specified in the CRF table and thereby ensuring transparency.</p>	Yes. Transparency
I.24	2.B.9 Fluorochemical production – HFCs	<p>The ERT noted that in CRF table 2(II)B-Hs1, emissions of HFC-23 were reported under production of HCFC-22 (0.17 t HFC-23 in 2017), but according to the NIR, HCFC-22 production ceased in the country in 2016 (p.244). During the review, the United Kingdom explained that the operator of the plant manufacturing HCFC-22 reported HFC-23 emissions from HCFC-22 production in 2017 and emissions were included in the inventory under category 2.B.9 as fugitive emissions from HCFC-22 production. The Party indicated that it would consult the plant operator to clarify why emissions were reported after production ended. The ERT concludes that the reporting of HFC-23 emissions from HCFC-22 is not transparent because HCFC-22 production does not occur in the United Kingdom.</p> <p>The ERT recommends that the United Kingdom investigate why the operator of the plant manufacturing HCFC-22 continued to report HFC-23 emissions after production of HCFC-22 ended in the country in 2016, and pending the outcome of this investigation, recalculate the HFC-23 emission estimates, as appropriate.</p>	Yes. Transparency
I.25	2.C.1 Iron and steel production – CO ₂	<p>The ERT noted that CO₂ emissions from the use of blast furnace gas, coke oven coke, fluxing agents, fuel oil and coal for pig iron production (except for losses of blast furnace gases) were reported in the energy sector under category 1.A.2 (manufacturing industries and construction) (NIR, p.146). The ERT also noted that the CO₂ IEF for pig iron production reported in CRF table 2(I).A-Hs2 (e.g. 0.18 t CO₂/t pig iron in 2017) is significantly lower than the IPCC default EF provided in the 2006 IPCC Guidelines (vol. 3, chapter 4, table 4.1) (1.35 t CO₂/t pig iron produced). During the review, the United Kingdom explained that all emissions associated with blast furnace gas use</p>	Yes. Comparability

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
I.26	2.C.5 Lead production – CO ₂	<p>except for losses were reported under the energy sector and because of this, the CO₂ IEF for pig iron production is significantly lower than the IPCC default value. During the review, the ERT analysed the carbon balance model for CO₂ emission estimates for iron and steel production in the United Kingdom and came to the conclusion that the total CO₂ emission estimates were accurate. The ERT noted that the estimates are confirmed by EU ETS reports and peer reviews of the carbon balance model. However, the ERT concludes that the CO₂ emissions from pig iron production are not comparable with those of other Parties because of their incorrect allocation between the energy and IPPU sectors.</p> <p>The ERT recommends that the United Kingdom reallocate CO₂ emissions from iron and steel production related to the use of blast furnace gas, coke oven coke, fluxing agents, fuel oil and coal from the energy sector to the IPPU sector in accordance with the 2006 IPCC Guidelines (vol. 3, chap. 4).</p> <p>The ERT noted that according to the NIR, other non-ferrous metals, except for aluminium, have not been produced in the United Kingdom since 2003 (p.111), but according to NIR figure 2.17, there were three other non-ferrous plants in operation in 2017 in addition to aluminium plants. Further, the ERT noted that according to the <i>United Kingdom Minerals Yearbook 2018</i> (British Geological Survey, 2019), lead is produced in the country. During the review, the United Kingdom explained that there were three sites producing lead in 2017: Britannia Refined Metals (refining of lead bullion, possibly also recovery of lead from batteries), HJ Enthoven (recovery of lead from batteries) and Envirowales (recovery of lead from batteries). These sites use fossil fuels to melt lead and also carry out simple refining operations such as the desilvering process that occurs at Britannia Refined Metals (using zinc metal). The Party has no evidence that the processes carried out at any of these works emit CO₂ emissions from any source other than fossil fuel combustion. The ERT agrees with the Party that non-process CO₂ emissions from lead production at these three sites are to be reported under the energy sector. The ERT concludes that the CO₂ emission estimates from secondary lead production are complete (as they are reported in the energy sector) but the description of category 2.C (metal industry) is not transparent regarding secondary lead production in the United Kingdom.</p> <p>The ERT recommends that the United Kingdom describe in the NIR the process or processes for secondary lead production in the country and report AD for lead production in CRF table 2(I).A-Hs2 based on, for example, data on lead production provided in the <i>United Kingdom Minerals Yearbook 2018</i> (p.37) (British Geological Survey, 2019) and earlier editions. The ERT also recommends that the Party report CO₂ emissions from lead production either as “NA” in CRF table 2(I).A-Hs2, explaining in the NIR that the technologies applied for lead production do not result in process emissions and that energy-related emissions from lead production are reported under the energy sector, or as “IE” if the process emissions occur but are reported under another category, specifying the category.</p>	Yes. Transparency
I.27	2.D.1 Lubricant use – CO ₂	<p>The ERT noted that CO₂ emissions from lubricants used in engines (except for lubricants used in mopeds, which is deemed to be intentional fuel use and hence reported under category 1.A.3.b.iv (motorcycles)) were estimated and reported under category 2.D.1 (NIR, p.257). However, the NIR does not contain any explanation as to which lubricants were accounted for and reported under this category. According to the 2006 IPCC Guidelines (vol. 3, chap. 5.2.2.2), CO₂ emissions from motor oils/industrial oils and greases are to be included under category 2.D.1. During the review, the United Kingdom provided the ERT with initial data from the energy balance used in the estimates and confirmed that both motor oils/industrial oils and greases were included in the estimates under category 2.D.1. The ERT concludes that the emission estimates are complete but the description of the lubricants included in the estimates is not transparent.</p>	Yes. Transparency

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
I.28	2.E.4 Heat transfer fluid – PFCs	<p>The ERT recommends that the United Kingdom provide in the NIR a description of all types of lubricants included in the estimates of CO₂ emissions from lubricant use, including motor oils/industrial oils and greases.</p> <p>The ERT noted that in CRF table 2(I)s2, PFC emissions from categories 2.E.2 (thin-film transistor flat panel display), 2.E.3 (photovoltaics) and 2.E.4 (heat transfer fluid) were reported as “NO”. The ERT also noted that in sections 4.26, 4.27 and 4.28 of the NIR it is stated that the absence of PFC emissions was confirmed by the market analysis prepared by Ricardo (2016). During the review, the United Kingdom provided the ERT with this report. The ERT noted that according to the report, perfluorohexanes are used in the country as heat transfer fluids and emitted in amounts of less than 2 kt CO₂ eq per year. The PFC emissions from categories 2.E.2 and 2.E.3 were confirmed as “NO” on the basis of consultation with manufacturers and suppliers (Ricardo, 2016). The ERT concludes that although the inventory is incomplete with respect to perfluorohexane emissions from category 2.E.4, the estimated emissions are below the threshold of significance included in the paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines for the United Kingdom (237 kt CO₂ eq in 2017) and therefore below the threshold for inclusion of this issue in the list of potential problems and further questions raised by the ERT in accordance with decision 22/CMP.1 in conjunction with decision 4/CMP.11, annex, paragraph 80(b).</p> <p>The ERT recommends that the United Kingdom report perfluorohexane emissions from category 2.E.4 in CRF table 2(II)B-Hs1, or report the emissions as “NE” instead of as “NO” and provide in the NIR information demonstrating that these emissions are below the threshold of significance in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.</p>	Yes. Completeness
I.29	2.F.1 Refrigeration and air conditioning – HFCs	<p>The ERT noted that HFC emissions from category 2.F.1 (refrigeration and air conditioning) significantly decreased between 2015 (13,369.52 kt CO₂ eq) and 2017 (11,636.57 kt CO₂ eq) – by 13.0 per cent. The ERT also noted that the United Kingdom contributed 39.11 per cent of European Union HFC emission reductions in the same period (European Union HFC emissions from category 2.F.1 decreased by 4,430.54 kt CO₂ eq to 93,047.74 kt CO₂ eq in 2017). However, the share of HFC emissions from the United Kingdom in the total HFC emissions from category 2.F.1 of the European Union is only 12.5 per cent. During the review, the ERT analysed in detail the HFC model used by the Party to estimate emissions from category 2.F.1. The ERT noted that the model is based on AD for HFC applications from 2010 and earlier years and assumptions based on the European Union F-gas regulation of 2014 (regulation 517/2014). The ERT also noted that assumptions for some HFC replacements and reductions are optimistic (e.g. according to the regulation, a prohibition on refrigerators and freezers for commercial use containing HFCs with GWPs of 2,500 or more will commence on 1 January 2020; however, according to the HFC model’s assumption, limiting the consumption of HFCs by commercial refrigerators began several years ago). The ERT concludes that HFC emissions from category 2.F.1 may not be accurate because of the adopted assumptions and relatively old AD. The United Kingdom is aware of the limitations of the current model and informed the ERT about an ongoing study to update it, explaining the general approach for its development. The ERT commends the Party for developing a new HFC model, which will ensure the latest available AD and assumptions are used for estimating HFC emissions. The Party indicated that it would revise the HFC emission estimates for category 2.F.1 in the 2020 or 2021 annual submission. The ERT believes that future ERTs should continue to monitor the progress of reporting of the emission estimates for this category to ensure that emissions are not underestimated.</p> <p>The ERT recommends that the United Kingdom include in the NIR a justification that the assumptions made in the HFC model accurately reflect the actual HFC trends, and encourages the Party to include in that justification an</p>	Yes. Transparency

<i>ID#</i>	<i>Finding classification</i>	<i>Description of the finding with recommendation or encouragement</i>	<i>Is finding an issue and/or a problem?^a</i>
		<p>explanation of how the HFC emission estimates obtained from the model are consistent with the European Union's overall HFC emission trends for category 2.F.1. The ERT also recommends that the Party implement the provisions of paragraph 50(a) of the UNFCCC Annex I inventory reporting guidelines and include in the NIR information that will improve the transparency of the HFC model; in particular, the ERT encourages the United Kingdom to provide information on key assumptions, the estimation of model parameters, key inputs and outputs, model calibration and model evaluation. The ERT also encourages the Party to finalize the ongoing development of the new HFC model and revise the HFC emission estimates under category 2.F.1 using the most relevant data.</p>	
I.30	2.F.1 Refrigeration and air conditioning – HFCs	<p>The ERT noted that the HFC model used for estimating HFC emissions from category 2.F.1 is based on the assumption that some HFCs with high GWPs are replaced by other HFCs and blends of gases with lower GWPs (e.g. HFC-32 is used to replace R134a, R407a, R410a and HFO; and HFO and HFC blends are used to replace R134a and R404a). The ERT also noted that HFO alone and HFO and HFC blends are used in the model for replacing some HFCs with higher GWPs; for example, HFO type 1 (GWP 5), HFO type 2 (GWP 600) and HFO type 3 (GWP 1,000). However, the ERT noted that emissions associated with HFO type 1, 2 and 3 applications were not reported under category 2.F.1. According to the HFC model, emissions from HFO type 1 were 22.99 kt CO₂ eq, from HFO type 2 were 51.17 kt CO₂ eq and from HFO type 3 were 1.10 kt CO₂ eq in 2017.</p> <p>The ERT encourages the United Kingdom to clarify if HFC emissions are occurring from the use of HFO types 1, 2 and 3 and report the HFC emissions under the relevant applications of category 2.F.1, if relevant.</p>	Not an issue/problem
I.31	2.F.4 Aerosols – HFCs	<p>The ERT noted that the methodology the United Kingdom used for estimating HFC emissions from aerosols (NIR, p.276) is different from the methodology recommended by the 2006 IPCC Guidelines (vol. 3, section 7.3.2.1). In particular, in the Party's assessment, 1 per cent of HFC emissions from aerosols occur during product manufacture, 97 per cent during product lifetime and 2 per cent at the end of product life. However, according to the 2006 IPCC Guidelines, 50 per cent of the initial charge of aerosols is emitted in the first year and 50 per cent in the second year of aerosols use. The 2006 IPCC Guidelines also suggest that compilers should use alternative EFs only when empirical evidence for these factors is available (vol. 3, section 7.3.2.2). During the review, the United Kingdom could not provide a justification for the EFs applied for estimating HFC emissions from aerosols. The ERT concludes that the estimates are not accurate because the methodology applied by the Party does not take into account the delay in aerosols use. The ERT believes that future ERTs should consider this issue further to ensure that emissions from this category are not underestimated.</p> <p>The ERT recommends that the United Kingdom include in the NIR a justification for the choice of the current EFs for aerosols production and use (i.e. 1 per cent of HFC emissions from aerosols occur during product manufacture, 97 per cent during product lifetime and 2 per cent at the end product of life) or estimate HFC emissions from aerosols in accordance with the 2006 IPCC Guidelines.</p>	Yes. Accuracy
Agriculture			
A.9	3. General (agriculture) – CO ₂ , CH ₄ and N ₂ O	<p>The United Kingdom did not include in the agriculture sector chapter of its NIR a description of trends in emissions, inter-annual variations in emissions and/or the main drivers of emissions, by category, in line with the appendix of the UNFCCC Annex I inventory reporting guidelines. The ERT notes that the Party including in the NIR more detailed information on emission trends by category could improve the transparency of the inventory submission. As an example of such information, during the review, the United Kingdom explained that the occurrence of foot and</p>	Not an issue/problem

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
		mouth disease caused a cull of cattle in 2001, decreasing the population and emissions for the year 2001 at the same time. The ERT encourages the United Kingdom to increase the transparency of the agriculture sector chapter of its NIR by including detailed descriptions of trends in emissions, inter-annual variations in emissions and all main drivers of the trends for each category.	
A.10	3. General (agriculture) – CO ₂ , CH ₄ and N ₂ O	Owing to time constraints, the United Kingdom has not updated since the 2017 annual submission the uncertainty analysis to fully reflect the changes to uncertainty due to the adoption of new methods and data, for example, for estimating emissions from enteric fermentation (NIR, p.309). During the review, the Party indicated that it would review the uncertainty parameters for the next annual submission. The ERT recommends that the United Kingdom update the uncertainty analysis for all categories, including enteric fermentation, for which significant data or methodological changes have occurred since the previous uncertainty analysis was conducted.	Yes. Convention reporting adherence
A.11	3. General (agriculture) – CH ₄ and N ₂ O	The United Kingdom applied an agriculture sector model with a fully revised structure for the 2019 submission to enable better representation of the key underlying driving variables of the GHG emissions from the sector, including soil, climate, livestock and cropping characteristics; farm management practices; and the uptake of specific climate change mitigation methods. The ERT reviewed the model during the review and commends the Party for improving its estimation methods in order to increase the accuracy of its inventory. However, the ERT notes that the transparency of the model description in the NIR could be improved. The ERT encourages the United Kingdom to include in its NIR, for example as part of annex 3, (1) detailed information on the agriculture sector model, including its basis, type, application, adaptation, main equations and processes, key assumptions, domain of application, parameters (how they were estimated), key inputs and outputs, calibration, evaluation, uncertainty and sensitivity analyses, QA/QC procedures and references to peer-reviewed literature, in line with footnote 11 to paragraph 50(a) of the UNFCCC Annex I inventory reporting guidelines; (2) a comparative analysis of emissions resulting from the agriculture sector model and those resulting from applying the tier 2 or 3 and tier 1 methodologies; and (3) a diagram showing the data and procedures flow for the agriculture sector model.	Not an issue/problem
A.12	3. General (agriculture) – CH ₄ and N ₂ O	The Party applied United Kingdom (England, Wales, Scotland and Northern Ireland) IEFs to estimate CH ₄ and N ₂ O emissions from enteric fermentation, manure management and agricultural soils in the Crown dependencies. During the review, the ERT checked the calculations made by the Party for estimating the emissions from these categories and found that the United Kingdom IEFs used in the spreadsheet for calculating emissions in 2016 and 2017 were from 2015. The Party explained to the ERT that it applied 2015 United Kingdom IEFs owing to the limited time available for preparing the estimates between receiving data from the Crown dependencies and submitting the inventory to the European Union and subsequently the secretariat. The ERT notes that, considering the relatively small amount of emissions from the Crown dependencies, an error introduced in the emissions from the use of constant IEFs for 2016 and 2017 would be below the threshold of significance in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines and therefore below the threshold of significance for inclusion of this issue in the list of potential problems and further questions raised in accordance with decision 22/CMP.1 in conjunction with decision 4/CMP.11, annex, paragraph 80(b).	Yes. Accuracy

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
		<p>The ERT recommends that the United Kingdom improve the accuracy of emission estimates for enteric fermentation, manure management and agricultural soils reported for the Crown dependencies by applying a splicing technique (e.g. extrapolation) from the 2006 IPCC Guidelines (vol. 1, chap. 5), to estimate the IEFs for the Crown dependencies instead of maintaining a constant IEF in years for which updated United Kingdom IEFs are not available in sufficient time to apply them to the emission estimates for the Crown dependencies. The ERT encourages the Party to assess, and if appropriate improve, the inventory planning processes between mainland United Kingdom and the Crown dependencies to ensure that the Crown dependencies emission estimates contain the latest available data from the mainland United Kingdom.</p>	
A.13	3.B Manure management – CH ₄ and N ₂ O	<p>The United Kingdom reported the amount of N in composting and digesters MMS as “NE” in CRF tables 3.B(b) and 3.B(a)s2 for all livestock types. During the review, the Party explained to the ERT that information on the amount of N distributed in composting and digesters MMS is not available owing to the lack of robust information on animal distribution in these MMS. Further, the Party explained that composting and use of digesters are not common practices in the country, and, in any case, the amount of N that could be included in composting and digesters MMS is currently included in solid storage MMS, therefore, emissions are reported accordingly. The United Kingdom indicated that data for manure managed by anaerobic digesters had been collected and would be included in a future submission. The ERT noted that if the Party updates its MMS animal distribution (including in composting and digesters MMS) this will also impact reported CH₄ emissions through the updated methane conversion factor for these MMS.</p> <p>The ERT recommends that the United Kingdom estimate the animal distribution in composting and digesters MMS to estimate CH₄ and N₂O emissions from manure management, using expert judgment to estimate the animal distribution in both MMS until which time the country-specific data are available for inclusion in the submission.</p>	Yes. Accuracy
A.14	3.B.4 Other livestock – N ₂ O	<p>The United Kingdom reported the amount of N from poultry manure burned for fuel or as waste in MMS as “NE” in CRF table 3.B(b). The ERT noted that the NIR does not include an explanation of this poultry manure management practice. During the review, the Party explained that poultry manure is burned after its treatment in solid storage MMS. The amount of N in burned poultry manure is discounted from the total amount of N applied to soils and is reported under the energy sector (when the manure is burned for energy purposes) or under the waste sector (when the manure is burned without energy recovery). The ERT agrees with the calculations applied by the Party.</p> <p>The ERT recommends that the United Kingdom report the notation key “NO” instead of “NE” in CRF table 3.B(b) for the amount of N from burned poultry manure to reflect the fact that poultry manure is burned after treatment and the combustion-related CH₄ and N₂O emissions are reported under the energy sector (when the manure is burned for energy purposes) or under the waste sector (when the manure is burned without energy recovery). The ERT also recommends that the United Kingdom include in the NIR an explanation of the poultry manure management practice and the final destination of the manure.</p>	Yes. Comparability
A.15	3.J Other (CO ₂ emissions from liming, urea application and other carbon-containing	<p>The United Kingdom reported all CO₂, CH₄ and N₂O emissions estimated from enteric fermentation, manure management, agricultural soils, liming and urea application for overseas territories and Crown dependencies under category 3.J in CRF table 3s2 (emissions reported in kt for each GHG). The ERT notes that this is not in line with the UNFCCC Annex I inventory reporting guidelines, in which emissions from enteric fermentation are to be reported under category 3.A (enteric fermentation), emissions from manure management under category 3.B (manure management), emissions from agricultural soils under category 3.D (direct and indirect N₂O emissions from</p>	Yes. Comparability

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
	fertilizers) – CO ₂ , CH ₄ and N ₂ O	<p>agricultural soils), emissions from liming under category 3.G (liming) and emissions from urea application under category 3.H (urea application).</p> <p>The ERT recommends that the United Kingdom report emissions from overseas territories and Crown dependencies in the respective categories (3.A (enteric fermentation), 3.B (manure management), 3.D (direct and indirect N₂O emissions from agricultural soils), 3.G (liming) and 3.H (urea application)).</p>	
LULUCF			
L.32	4. General (LULUCF)	<p>The United Kingdom used a tier 3 approach based on the CARBINE model to estimate changes in carbon stock in forest land. During the review, the ERT made reference to the report on the IPCC expert meeting on the use of models and measurements in GHG inventories (IPCC, 2011), which presents a list of typical items that, when reported, may lead to improved transparency in emission/removal estimates that are based on models. The following items are mentioned in the report regarding a model: basis, type, application, adaptation, main equations and processes, key assumptions, domain of application, parameters (how they were estimated), key inputs and outputs, calibration, evaluation, uncertainty and sensitivity analyses, QA/QC procedures and references to peer-reviewed literature. Many of these items are also referenced in footnote 11 to the UNFCCC Annex I inventory reporting guidelines. During the review, the United Kingdom provided the ERT with a file containing comprehensive information on each item, including references and the relevant peer-reviewed literature. The ERT commends the Party for providing information during the review that improves the transparency of the CARBINE model.</p> <p>The ERT encourages the United Kingdom to include in the NIR information on its work done in addressing the items included in footnote 11 to the UNFCCC Annex I inventory reporting guidelines and as elaborated in chapter 3 of the report on the IPCC expert meeting on the use of models and measurements in GHG inventories (IPCC, 2011).</p>	Not an issue/problem
L.33	4. General (LULUCF)	<p>The United Kingdom provided in NIR table A.3.6.5 the estimates of direct GHG emissions from LULUCF for the Cayman Islands, the Falklands Islands and Bermuda. During the review, in response to a question from the ERT regarding the estimates provided in the table, the Party clarified that the values are for the Falklands Islands only and are not aggregated estimates for the three overseas territories.</p> <p>The ERT recommends that the United Kingdom clarify either in the heading of NIR table A.3.6.5 or in a footnote to that table the specific overseas territories and/or Crown dependencies included in the emission estimates for specific categories of the LULUCF sector (if different from the heading).</p>	Yes. Transparency
L.34	4. General (LULUCF)	<p>The ERT identified some inconsistencies between the NIR and the CRF tables; for instance, the area of grassland for 2015, which in NIR table 6.2 is 13,321 kha and in CRF table 4.1 is 14,580.25 kha. For 2015, the final area for grassland in CRF table 4.C is 14,387.38 kha. The ERT noted that a smaller number of inconsistencies between the NIR and the CRF tables were present than in the previous submission, but considers that further efforts to enhance QA/QC are needed. During the review, the Party acknowledged the inconsistencies.</p> <p>The ERT recommends that the United Kingdom correct the inconsistencies for grassland area between the NIR and CRF tables 4.1 and 4.C for the entire times series.</p>	Yes. Convention reporting adherence
L.35	4. General (LULUCF)	<p>In the NIR (p.115), the United Kingdom reported that the LULUCF sector covers emissions and removals of direct and indirect GHGs from eight land-use categories: 4.A (forest land), 4.B (cropland), 4.C (grassland), 4.D (wetlands), 4.E (settlements), 4.F (other land), 4.G (HWP) and 4.H other (LULUCF). The ERT noted that HWP is not a land-use</p>	Yes. Transparency

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
		<p>category but is considered as a pool in the 2006 IPCC Guidelines (e.g. vol. 4, p.12.9). Other is also not considered a land-use category. During the review, the Party agreed with the ERT's assessment.</p> <p>The ERT recommends that the United Kingdom refer to HWP as a pool rather than a land-use category in the annual submission and consider as land-use categories only those six land uses included in the 2006 IPCC Guidelines (vol. 4, pp.3.6–3.7), that is, categories 4.A (forest land), 4.B (cropland), 4.C (grassland), 4.D (wetlands), 4.E (settlements) and 4.F (other land).</p>	
L.36	4.B.1 Cropland remaining cropland – CO ₂	<p>The United Kingdom reported changes in carbon stock in cropland using a tier 3 dynamic soil carbon model (NIR, p.345). According to the 2006 IPCC Guidelines (vol. 4, equation 2.24), the estimation of changes in carbon stocks in soils using a tier 3 approach includes the annual change in inorganic carbon stock, which is assumed to be zero when applying tier 1 and tier 2 methods. The ERT did not find in the NIR any information indicating the inclusion of changes in inorganic carbon stocks when estimating changes in carbon stocks in soils. During the review, the Party explained that it does not currently consider changes in inorganic carbon stocks, and has no plans to do so in the short term, as other inventory improvements have taken priority. However, the United Kingdom provided the ERT with the results of some country-specific research on inorganic carbon stocks in the surface horizon of English soils. According to Rawlins et al. (2011), inorganic carbon may represent approximately 15.5 per cent of the carbon stored in the top 30 cm of the soil in England but the primary carbonate content is likely to change relatively slowly with time, hence no substantial difference is likely to occur in relation to the total stock of inorganic carbon. The ERT concludes that further research on this issue could enhance knowledge regarding the changes in inorganic carbon stocks in soils, and inclusion of these estimates is consistent with the application of a tier 3 dynamic soil carbon model.</p> <p>The ERT recommends that the United Kingdom develop a plan for estimating the annual change in inorganic carbon stock in soils, even if this is not a priority at present, and until the estimates can be included in the submission, include in the NIR information on the possible contribution of inorganic carbon stocks to changes in carbon stocks in soils based on the available literature.</p>	Yes. Accuracy
L.37	4(II) Emissions and removals from drainage and rewetting and other management of organic/mineral soils – CO ₂ and CH ₄	<p>The United Kingdom reported in the NIR that all cropland on organic soils is assumed to be drained, and occurs mainly in England (p.346). The ERT noted that the areas of and CO₂ emissions from the drainage of organic soils in cropland, for the United Kingdom, overseas territories and Crown dependencies, are reported as “IE” in CRF table 4(II). CH₄ emissions from the drainage of organic soils in cropland are reported as “NE” in CRF table 4(II) for the United Kingdom, overseas territories and Crown dependencies owing to insufficient information, as reported in CRF table 9. During the review, in response to a question from the ERT regarding clarification of the use of “IE” in CRF table 4(II) for the area of cropland organic soils drained (mainland United Kingdom only), the Party explained that the comment that should have been appended to the table was likely lost during the upload of the data to CRF Reporter and should have read “Reported in table 4B”. The ERT appreciates the clarification provided by the United Kingdom and understands that the notation keys used in the 2019 annual submission will be replaced with actual estimates after the research from Evans et al. (2017) is implemented in the LULUCF sector.</p> <p>The ERT recommends that, until the notation keys can be replaced with actual estimates, the United Kingdom review the final submission to ensure that the use of the notation key “IE” in CRF table 4(II) for the area of organic soils drained in cropland in mainland United Kingdom is explained in CRF table 9.</p>	Yes. Transparency

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
Waste			
W.16	5.A Solid waste disposal on land – CH ₄	<p>The United Kingdom reported the use of a tier 2 methodology (the MELMod model), which is based on national waste quantities, composition, properties and disposal practices (NIR, p.379), for estimating the emissions from landfills. As described in the waste sector methodology section (NIR, pp.380–381), CH₄ generation from solid waste disposal is calculated using a methodology adapted from equations 3.1–3.6 of the 2006 IPCC Guidelines (vol. 5). In the model, the Party uses country-specific parameters for DOC, DOC_f and the composition of waste material, as reported in NIR table A.3.5.2. The other input parameters to the model, including MCF, oxidation factor and the fraction of CH₄ in generated landfill gas, are adapted from IPCC default values. The IPCC default FOD rate constant (k) for wet boreal and temperate climate conditions is also applied (see ID# W.2 in table 3). During the review, the United Kingdom demonstrated the MELMod model spreadsheet and input parameters used in the model and explained that the equations in the model are exactly the same as those of the IPCC FOD methodology. The MELMod spreadsheet allows the Party to apply country-specific DOC and DOC_f parameters based on chemical properties (i.e. lignin, cellulose, hemicellulose, fat, sugar and protein content) specific to the composition of the waste material of the United Kingdom while applying IPCC default values for the remaining parameters.</p> <p>The ERT encourages the United Kingdom to report in the NIR that it applies the IPCC FOD methodology for estimating CH₄ emissions from solid waste disposal to avoid confusion regarding the difference between the MELMod model and the IPCC FOD methodology.</p>	Not an issue/problem
W.17	5.A Solid waste disposal on land – CH ₄	<p>The United Kingdom performed QA/QC and verification of CH₄ emission estimates following the 2006 IPCC Guidelines (vol. 5, section 3.8) by comparing emissions calculated from the MELMod model with emission estimates for Ireland and Italy. Moreover, the MELMod model was peer reviewed in 2011 and 2014. The comparison determined that the amount of CH₄ generated in all three countries was in the range 24–50 kt CH₄/Mt waste landfilled (the value for the United Kingdom was in the range 28–44 kt CH₄/Mt waste landfilled) with no obvious inconsistency in the estimated CH₄ collection efficiencies (62 per cent for the United Kingdom, 63 per cent for Ireland and 81 per cent for Italy in 2015). During the review, the Party explained that the comparison was performed to compare the CH₄ collection efficiencies among the countries but not for the purpose of verifying the MELMod model. The Party also explained that verification of the MELMod model was carried out by comparing the estimation of emissions from the United Kingdom's tier 2 model and from the IPCC tier 1 model set up to reflect United Kingdom waste characteristics and IPCC tier 1 default inputs. The results obtained using the two models were similar. The comparison of results was demonstrated in graphic form to the ERT during the review, but the magnitude of the difference between the estimates obtained using the two models was not provided. The ERT commends the Party for conducting a peer review of the tier 2 country-specific MELMod model.</p> <p>The ERT encourages the United Kingdom to include in the NIR (section 7.2.5) information on any differences resulting from a comparison between the estimation of emissions using the United Kingdom tier 2 model and the IPCC tier 1 model.</p>	Not an issue/problem
W.18	5.A Solid waste disposal on land – CH ₄	<p>The United Kingdom reported the composition of waste sorting residues and mixed municipal waste in NIR table A.3.5.1; the data are based on a survey carried out on behalf of Defra (Resource Futures, 2012). The composition of the waste used in the estimation of emissions was assumed to be constant over the entire time series. During the review, the Party explained that the composition of mixed waste from the study in 2012 was the only available</p>	Yes. Accuracy

<i>ID#</i>	<i>Finding classification</i>	<i>Description of the finding with recommendation or encouragement</i>	<i>Is finding an issue and/or a problem?^a</i>
		<p>information for estimating emissions from this category. The Party recognizes that the composition of mixed waste could change over time and that assuming the composition to be constant may lead to inaccurate emission estimates.</p> <p>The ERT recommends that the United Kingdom investigate the availability of alternative data sources for the composition of mixed waste and update the waste composition data used for estimating emissions from this category accordingly, or, if this is not possible for a given annual submission, provide a justification in the NIR that the waste composition data used are representative of current national circumstances.</p>	
W.19	5.A Solid waste disposal on land – CH ₄	<p>In NIR table A.3.5.5, the United Kingdom described the parameters used for estimating landfill emissions for the overseas territories and Crown dependencies. The information includes the AD, MCF and DOC used in the estimation but there is no information about the first-order decay rate constant (k) applied. During the review, the Party provided information on the k value applied, referring to default values specified in the 2006 IPCC Guidelines for different climate zones (vol. 5, table 3.3), as follows: Falkland Islands (Malvinas) (wet temperate), Cayman Islands and Bermuda (moist and wet tropical), and Isle of Man and Guernsey (wet temperate).</p> <p>The ERT recommends that the United Kingdom provide in NIR table A.3.5.5 the FOD rate constant (k) values used for estimating landfill emissions for the overseas territories and Crown dependencies.</p>	Yes. Transparency
W.20	5.A Solid waste disposal on land – CH ₄	<p>In the NIR (p.383), the United Kingdom described the estimation of CH₄ recovered from landfills, which was reported in NIR table A.3.5.4. The recovered CH₄ was estimated from the renewable energy generated from the combustion of landfill gas, as reported in DUKES. In 2017, this renewable energy was 4,284 GWh, whereas 857 kt CH₄ was estimated to be consumed for electricity generation. The Party's assumptions regarding the relationship between CH₄ consumption and electricity generation were not described in the NIR. During the review, the Party explained this relationship, including its assumptions for landfill gas recovery percentages and of efficiencies of landfill gas engines used in the calculation for the time series (1990–2017).</p> <p>The ERT recommends that the United Kingdom provide in the NIR a clear explanation of and justification for the assumption used for conversion between the CH₄ used for power generation reported in the waste sector and electricity produced from landfill gas reported in the energy sector.</p>	Yes. Transparency
W.21	5.B.1 Composting – CH ₄ and N ₂ O	<p>In CRF table 5.B, the United Kingdom reported AD for the amount of municipal solid waste treated by composting in kt dry mass (kt dry matter). The Party used default EFs from the 2006 IPCC Guidelines (vol. 5, table 4.1) for this biological treatment process: 10 g/kg dry weight for CH₄ and 0.6 g/kg dry weight for N₂O for composting were used for estimating the emissions. However, it is unclear why the AD reported in NIR table A.3.5.6 are in a wet weight unit. During the review, the Party explained that while the AD for municipal solid waste treated by composting are reported in the NIR on a wet weight basis, these values are required to be reported on a dry weight basis in the CRF tables. The United Kingdom applied a factor of 0.4, which is the IPCC default, for converting wet mass to dry mass.</p> <p>The ERT recommends that the United Kingdom report in NIR table A.3.5.6 the AD for the annual amount of waste treated in the composting process in the same units as those in CRF table 5.B, and explain in the NIR the assumption used in converting the AD between weight and dry weight.</p>	Yes. Transparency
W.22	5.D.1 Domestic wastewater – CH ₄	<p>The ERT noted that the United Kingdom used the total amount of sludge disposed (in kt dry sludge/year) at sewage treatment plants for estimating CH₄ emissions from sludge treatment. For the population served by private wastewater treatment systems, population and per capita BOD load were used for estimating total BOD load (in kt</p>	Yes. Transparency

ID#	Finding classification	Description of the finding with recommendation or encouragement	Is finding an issue and/or a problem? ^a
W.23	5.D.2 Industrial wastewater – CH ₄	<p>BOD/year). Both AD were combined and reported as total organic product (kt DC) in CRF table 5.D, and sludge mass unit (total dissolved solids) was assumed to be comparable with BOD. The ERT considers the reporting of AD for private wastewater treatment systems as kt DC comparable with BOD is not consistent with the 2006 IPCC Guidelines. In response to a question from the ERT, the United Kingdom explained that the CH₄ emissions were estimated by multiplying the total organic product by the CH₄ IEF (0.0196 kg CH₄/kg DC in 2017) derived from the CH₄ IEF for sludge treatment (0.0109 kg CH₄/kg DC in 2017) and default CH₄ IEF for septic tanks (0.3 kg CH₄/kg BOD) (2006 IPCC Guidelines, vol. 5, chap. 6, tables 6.2 and 6.3). The ERT considers that estimating emissions by using sludge treatment and septic tank AD combined is not transparent as the mass of sludge (kg dissolved solids) and BOD (kg BOD) have different units, even though using the approach of combining them leads to the same emission estimate as if the two sources had been separately estimated.</p> <p>The ERT recommends that the United Kingdom calculate the emissions from sludge treatment at sewage treatment plants and private wastewater management systems using the EFs for sludge treatment and septic tanks, respectively, and report the emissions transparently in the NIR. The ERT encourages the Party to include in the documentation box of CRF table 5.D a reference to the description of the derivation of the IEF in the NIR.</p> <p>The United Kingdom reported AD for industrial wastewater for the food and drink industries in NIR table A.3.5.13 in the unit “million population equivalents (PE)”. In the NIR (p.405), the Party explained that the total organic load for the food and drink industry subcategories were obtained from a Defra study (2002) and scaled across the time series using data from the Index of Production data of the Office for National Statistics. The NIR does not, however, clearly explain how the emissions from the food and drink industries are estimated. During the review, the United Kingdom provided information on the conversion of population equivalent to BOD using BOD load per population (1 population equivalent = 0.054 kg/day); BOD is converted to COD using the IPCC default factor from 2006 IPCC Guidelines (vol. 5, p.6.12) (1 kg BOD = 2.4 kg COD) and the IPCC default CH₄ EF of COD from the 2006 IPCC Guidelines (vol. 5, table 6.2) (0.25 kg CH₄/kg COD). The ERT considers that the use of AD for industrial wastewater in this approach is not in line with the 2006 IPCC Guidelines, in which total organic degradable carbon is calculated from total industrial product (t), wastewater generated (m³/t product) and COD (kg/m³), as described in equation 6.6 of the 2006 IPCC Guidelines (vol. 5). The ERT notes that this results in a possible overestimation of emissions, as the United Kingdom adds the emissions from some industrial sources to the combined emissions from domestic and industrial wastewater (NIR, p.405).</p> <p>The ERT recommends that the United Kingdom improve the transparency of the industrial wastewater AD by presenting the assumptions used to convert these data to units suitable for applying IPCC default EFs and how these AD estimates differ from estimates derived from the methodology described in the 2006 IPCC Guidelines.</p>	Yes. Transparency
KP-LULUCF activities			
KL.22	General (KP-LULUCF activities)	<p>The ERT found it difficult to assess whether the United Kingdom had fulfilled the requirements under decision 2/CMP.8, annex II, as information relevant to the requirements was reported scattered throughout the NIR. For instance, the ERT could not find information for paragraph 5(c) on provisions related to the inclusion of carbon emissions and removals from forest areas afforested prior to 1921. The ERT notes that it would facilitate the complete assessment of the Party's reporting by future ERTs if the United Kingdom were to provide a table listing</p>	Not a problem

<i>ID#</i>	<i>Finding classification</i>	<i>Description of the finding with recommendation or encouragement</i>	<i>Is finding an issue and/or a problem?^a</i>
		the requirements in decision 2/CMP.8 and a cross reference to where in the NIR the corresponding information is reported, including for paragraph 5(c).	
		The ERT encourages the United Kingdom to include in the NIR a table listing all the requirements in decision 2/CMP.8, annex II, with a cross reference to the section in the NIR where the corresponding information is reported.	
KL.23	Article 3.4 activities – CO ₂ , CH ₄ and N ₂ O	<p>During the review, the ERT raised concerns regarding the fact that CM and GM lands and lands on which WDR occurs are not yet identifiable. In response to a question from the ERT on this issue, the United Kingdom explained that various options and data sources for identifying these lands are being explored, including moving from reporting method 1 in the Kyoto Protocol Supplement to the spatially explicit reporting method 2 in order to track land-use changes. However, the Party recognizes that there are challenges to implementing this approach before the end of the second commitment period, and is thus exploring other approaches, including a data assimilation approach that establishes land-use vectors by integrating the data available from various sources on land use and land-use change in the United Kingdom, starting with a data set available for Scotland (Levy et al., 2017). The ERT acknowledges the efforts made by the Party in identifying CM, GM and WDR lands.</p> <p>The ERT recommends that the United Kingdom explore how to make the best possible use of available data to meet the reporting requirements under the Kyoto Protocol for elected Article 3, paragraph 4, activities, a process that may benefit from expert meetings with potential data providers, and then prepare and implement a workplan to enable the use of these data.</p>	Yes. KP reporting adherence
KL.24	Article 3.4 activities – CO ₂ , CH ₄ and N ₂ O	<p>In the NIR (p.472), the United Kingdom reported that the area of GM reported under the Kyoto Protocol is broadly consistent with that reported as grassland under the Convention, and reported a difference of 2 per cent in the total area in 2017. According to the Party, the difference is due to the slightly different definitions used, with ‘grassland’ under the Convention defined as the area remaining after all other land areas have been identified, and ‘GM’ defined as the area of grassland in the Countryside Survey, which started in 1990. The ERT found a larger difference of approximately 3.8 per cent in 2017 (14,468.90 kha reported under the Convention in CRF table 4.C for grassland versus 15,014.60 kha reported under the Kyoto Protocol in CRF table 4(KP-I)B.3 for GM). During the review, the United Kingdom agreed with the assessment of the ERT and, in response to a question from the ERT on this matter, provided an explanation for the difference.</p> <p>The ERT recommends that the United Kingdom update the text in the NIR to explain (1) that the difference between the areas of GM under the Kyoto Protocol and grassland under the Convention arises from the different definitions used for grassland and GM and (2) the adjustment made to account for the area that has been converted from grassland but remains subject to GM.</p>	Yes. Transparency

^a Recommendations made by the ERT during the review are related to issues as defined in para. 81 of the UNFCCC review guidelines, or problems as defined in para. 69 of the Article 8 review guidelines.

VI. Application of adjustments

11. The ERT did not identify the need to apply any adjustments to the 2019 annual submission of the United Kingdom.

VII. Accounting quantities for activities under Article 3, paragraph 3, and, if any, activities under Article 3, paragraph 4, of the Kyoto Protocol

12. The United Kingdom has elected commitment period accounting and therefore the issuance and cancellation of units for KP-LULUCF activities is not applicable to the 2019 review.

VIII. Questions of implementation

13. No questions of implementation were identified by the ERT during the individual review of the Party's 2019 annual submission.

Annex I

Overview of greenhouse gas emissions and removals for the United Kingdom of Great Britain and Northern Ireland for submission year 2019 and data and information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, as submitted by the United Kingdom of Great Britain and Northern Ireland in its 2019 annual submission

1. Tables 1–4 provide an overview of total GHG emissions and removals as submitted by the United Kingdom.

Table 1

Total greenhouse gas emissions for the United Kingdom of Great Britain and Northern Ireland, base year^a–2017

(kt CO₂ eq)

	<i>Total GHG emissions excluding indirect CO₂ emissions</i>		<i>Total GHG emissions including indirect CO₂ emissions^b</i>		<i>Land-use change (Article 3.7 bis as contained in the Doha Amendment)^c</i>	<i>KP-LULUCF activities (Article 3.3 of the Kyoto Protocol)^d</i>	<i>KP-LULUCF activities (Article 3.4 of the Kyoto Protocol)</i>	
	<i>Total including LULUCF</i>	<i>Total excluding LULUCF</i>	<i>Total including LULUCF</i>	<i>Total excluding LULUCF</i>			<i>CM, GM, RV, WDR</i>	<i>FM</i>
FMRL								–8 268.00
Base year	801 048.77	800 793.31	NA	NA	246.05		7 632.37	
1990	797 405.13	797 149.67	NA	NA				
1995	748 787.20	750 498.54	NA	NA				
2000	711 031.13	714 905.78	NA	NA				
2010	604 336.79	613 446.54	NA	NA				
2011	556 713.78	566 288.54	NA	NA				
2012	573 874.45	582 878.21	NA	NA				
2013	559 785.11	569 127.30	NA	NA		3.49	7 467.41	–19 097.08
2014	519 166.16	528 730.88	NA	NA		–160.35	7 214.43	–18 660.53
2015	501 494.06	511 206.00	NA	NA		–567.99	7 097.93	–18 247.14
2016	476 457.87	486 256.75	NA	NA		–528.19	6 931.58	–17 985.44
2017	463 677.09	473 569.77	NA	NA		–1 001.71	6 799.75	–17 478.27

Note: Emissions/removals reported in the sector other (sector 6) are not included in the total GHG emissions.

^a “Base year” refers to the base year under the Kyoto Protocol, which is 1990 for CO₂, CH₄ and N₂O and 1995 for HFCs, PFCs, SF₆ and NF₃. The base year for CM, GM and WDR under Article 3, para. 4, of the Kyoto Protocol is 1990 for the United Kingdom. For activities under Article 3, para. 3, of the Kyoto Protocol and FM under Article 3, para. 4, only the inventory years of the commitment period must be reported.

^b The Party did not report indirect CO₂ emissions in CRF table 6.

^c The value reported in this column refers to 1990.

^d Activities under Article 3, para. 3, of the Kyoto Protocol, namely AR and deforestation.

Table 2

Greenhouse gas emissions by gas for the United Kingdom of Great Britain and Northern Ireland, excluding land use, land-use change and forestry, 1990–2017
(kt CO₂ eq)

	<i>CO₂^a</i>	<i>CH₄</i>	<i>N₂O</i>	<i>HFCs</i>	<i>PFCs</i>	<i>Unspecified mix of HFCs and PFCs</i>	<i>SF₆</i>	<i>NF₃</i>
1990	600 772.87	132 908.08	46 120.08	14 391.43	1 651.49	NO, NE	1 305.31	0.42
1995	566 657.20	126 327.08	36 521.97	19 094.58	596.90	NO, NE	1 299.96	0.83
2000	567 185.70	108 852.19	26 545.84	9 875.85	596.78	NO, NE	1 847.72	1.69
2010	511 831.41	64 259.51	19 903.76	16 461.12	287.71	NO, NE	702.75	0.27
2011	469 609.47	61 569.38	19 157.31	14 912.95	416.93	NO, NE	622.20	0.30
2012	487 633.42	59 936.62	18 990.46	15 459.51	255.04	NO, NE	602.84	0.33
2013	477 751.33	55 847.74	18 900.97	15 786.11	318.73	NO, NE	522.05	0.36
2014	438 874.17	53 650.07	19 446.73	15 980.89	278.31	NO	500.32	0.40
2015	422 412.77	53 053.40	18 980.08	15 966.87	327.23	NO	465.21	0.44
2016	399 838.87	51 472.87	18 903.17	15 196.82	353.94	NO	490.59	0.48
2017	387 387.32	51 849.75	19 261.70	14 173.58	371.47	NO	525.41	0.53
Per cent change 1990–2017	–35.5	–61.0	–58.2	–1.5	–77.5	NA	–59.7	27.8

Note: Emissions/removals reported in the sector other (sector 6) are not included in the total GHG emissions.

^a The United Kingdom did not report indirect CO₂ emissions in CRF table 6.

Table 3

Greenhouse gas emissions by sector for the United Kingdom of Great Britain and Northern Ireland, 1990–2017

(kt CO₂ eq)

	<i>Energy</i>	<i>IPPU</i>	<i>Agriculture</i>	<i>LULUCF</i>	<i>Waste</i>	<i>Other</i>
1990	614 553.52	66 557.45	49 171.86	255.46	66 866.84	NO
1995	572 294.02	60 856.11	47 952.20	–1 711.33	69 396.21	NO
2000	565 251.39	40 610.27	45 924.00	–3 874.65	63 120.12	NO
2010	506 913.75	35 550.82	40 912.06	–9 109.75	30 069.91	NO
2011	465 206.47	32 038.45	41 002.51	–9 574.76	28 041.11	NO
2012	483 403.61	32 381.19	40 627.61	–9 003.76	26 465.79	NO
2013	470 802.42	34 482.24	40 425.34	–9 342.19	23 417.30	NO
2014	431 563.61	34 195.67	41 791.05	–9 564.72	21 180.56	NO
2015	415 389.20	33 697.89	41 170.77	–9 711.94	20 948.14	NO
2016	393 882.16	30 856.69	41 189.79	–9 798.88	20 328.11	NO

	<i>Energy</i>	<i>IPPU</i>	<i>Agriculture</i>	<i>LULUCF</i>	<i>Waste</i>	<i>Other</i>
2017	381 085.17	30 311.22	41 546.82	–9 892.68	20 626.55	NO
Per cent change 1990–2017	–38.0	–54.5	–15.5	–3 972.5	–69.2	NA

Notes: (1) Emissions/removals reported in the sector other (sector 6) are not included in the total GHG emissions. (2) The United Kingdom did not report indirect CO₂ emissions in CRF table 6.

Table 4

Greenhouse gas emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol by activity, base year^a–2017, for the United Kingdom of Great Britain and Northern Ireland
(kt CO₂ eq)

	<i>Article 3.7 bis as contained in the Doha Amendment^b</i>	<i>Activities under Article 3, paragraph 3, of the Kyoto Protocol</i>		<i>FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol</i>				
	<i>Land-use change</i>	<i>AR</i>	<i>Deforestation</i>	<i>FM</i>	<i>CM</i>	<i>GM</i>	<i>RV</i>	<i>WDR</i>
FMRL				–8 268.00				
Technical correction				–9 384.00				
Base year	246.05				14 401.10	–6 768.73	NA	NE
2013		–1 208.95	1 212.44	–19 097.08	13 025.57	–5 558.15	NA	NE
2014		–1 485.40	1 325.05	–18 660.53	12 818.23	–5 603.80	NA	NE
2015		–1 817.48	1 249.48	–18 247.14	12 773.90	–5 675.97	NA	NE
2016		–2 138.66	1 610.47	–17 985.44	12 656.12	–5 724.53	NA	NE
2017		–2 440.76	1 439.05	–17 478.27	12 589.48	–5 789.73	NA	NE
Per cent change base year–2017					–12.6	–14.5	NA	NA

Note: Values in this table include emissions from land subject to natural disturbances, if applicable.

^a The base year for CM, GM and WDR under Article 3, para. 4, of the Kyoto Protocol is 1990 for the United Kingdom. For activities under Article 3, para. 3, of the Kyoto Protocol and FM under Article 3, para. 4, only the inventory years of the commitment period must be reported.

^b The value reported in this column refers to 1990.

2. Table 5 provides an overview of key relevant data from the United Kingdom's reporting under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

Table 5

Key relevant data for the United Kingdom of Great Britain and Northern Ireland under Article 3, paragraphs 3 and 4, of the Kyoto Protocol in the 2019 annual submission

<i>Key parameters</i>	<i>Values</i>
Periodicity of accounting	(a) AR: commitment period accounting (b) Deforestation: commitment period accounting (c) FM: commitment period accounting (d) CM: commitment period accounting (e) GM: commitment period accounting (f) RV: not elected (g) WDR: commitment period accounting
Election of activities under Article 3, paragraph 4	CM, GM and WDR
Election of application of provisions for natural disturbances	Yes, for AR and FM
3.5% of total base-year GHG emissions, excluding LULUCF	28 103.084 kt CO ₂ eq (224 824.677 kt CO ₂ eq for the duration of the commitment period) (see ID# KL.11 in table 3)
Cancellation of AAUs, CERs and ERUs and/or issuance of RMUs in the national registry for:	
1. AR	NA
2. Deforestation	NA
3. FM	NA
4. CM	NA
5. GM	NA
6. RV	NA
7. WDR	NA

Annex II

Information to be included in the compilation and accounting database

Tables 1–5 include the information to be included in the compilation and accounting database for the United Kingdom. Data shown are from the original annual submission of the Party, including the latest revised estimates submitted, adjustments (if applicable) and the final data to be included in the compilation and accounting database.

Table 1

Information to be included in the compilation and accounting database for 2017, including on the commitment period reserve, for the United Kingdom of Great Britain and Northern Ireland

(t CO₂ eq)

	<i>Original submission</i>	<i>Revised estimate</i>	<i>Adjustment</i>	<i>Final</i>
CPR	2 471 658 632	2 470 443 599	–	2 470 443 599
Annex A emissions for 2017	–	–	–	–
CO ₂ ^a	387 387 321	–	–	387 387 321
CH ₄	51 849 746	–	–	51 849 746
N ₂ O	19 261 704	–	–	19 261 704
HFCs	14 173 585	–	–	14 173 585
PFCs	371 474	–	–	371 474
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF ₆	525 407	–	–	525 407
NF ₃	531	–	–	531
Total Annex A sources	473 569 767	–	–	473 569 767
Activities under Article 3, paragraph 3, of the Kyoto Protocol for 2017	–	–	–	–
AR	–2 440 758	–	–	–2 440 758
Deforestation	1 439 045	–	–	1 439 045
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol for 2017	–	–	–	–
FM	–17 478 273	–	–	–17 478 273
CM	12 589 483	–	–	12 589 483
CM for the base year	14 401 097	–	–	14 401 097
GM	–5 789 729	–	–	–5 789 729
GM for the base year	–6 768 731	–	–	–6 768 731
WDR	NE	–	–	NE
WDR for the base year	NE	–	–	NE

^a The Party did not report indirect CO₂ emissions in CRF table 6.

Table 2

Information to be included in the compilation and accounting database for 2016 for the United Kingdom of Great Britain and Northern Ireland

(t CO₂ eq)

	<i>Original submission</i>	<i>Revised estimate</i>	<i>Adjustment</i>	<i>Final</i>
Annex A emissions for 2016	–	–	–	–
CO ₂ ^a	399 838 872	–	–	399 838 872
CH ₄	51 472 869	–	–	51 472 869
N ₂ O	18 903 173	–	–	18 903 173

	<i>Original submission</i>	<i>Revised estimate</i>	<i>Adjustment</i>	<i>Final</i>
HFCs	15 196 820	—	—	15 196 820
PFCs	353 941	—	—	353 941
Unspecified mix of HFCs and PFCs	NO	—	—	NO
SF ₆	490 590	—	—	490 590
NF ₃	482	—	—	482
Total Annex A sources	486 256 747	—	—	486 256 747
Activities under Article 3, paragraph 3, of the Kyoto Protocol for 2016	—	—	—	—
AR	–2 138 660	—	—	–2 138 660
Deforestation	1 610 472	—	—	1 610 472
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol for 2016	—	—	—	—
FM	–17 985 438	—	—	–17 985 438
CM	12 656 116	—	—	12 656 116
CM for the base year	14 401 097	—	—	14 401 097
GM	–5 724 533	—	—	–5 724 533
GM for the base year	–6 768 731	—	—	–6 768 731
WDR	NE	—	—	NE
WDR for the base year	NE	—	—	NE

^a The Party did not report indirect CO₂ emissions in CRF table 6.

Table 3

Information to be included in the compilation and accounting database for 2015 for the United Kingdom of Great Britain and Northern Ireland

(t CO₂ eq)

	<i>Original submission</i>	<i>Revised estimate</i>	<i>Adjustment</i>	<i>Final</i>
Annex A emissions for 2015	—	—	—	—
CO ₂ ^a	422 412 773	—	—	422 412 773
CH ₄	53 053 403	—	—	53 053 403
N ₂ O	18 980 077	—	—	18 980 077
HFCs	15 966 866	—	—	15 966 866
PFCs	327 229	—	—	327 229
Unspecified mix of HFCs and PFCs	NO	—	—	NO
SF ₆	465 208	—	—	465 208
NF ₃	438	—	—	438
Total Annex A sources	511 205 995	—	—	511 205 995
Activities under Article 3, paragraph 3, of the Kyoto Protocol for 2015	—	—	—	—
AR	–1 817 476	—	—	–1 817 476
Deforestation	1 249 483	—	—	1 249 483
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol for 2015	—	—	—	—
FM	–18 247 141	—	—	–18 247 141
CM	12 773 900	—	—	12 773 900
CM for the base year	14 401 097	—	—	14 401 097
GM	–5 675 968	—	—	–5 675 968
GM for the base year	–6 768 731	—	—	–6 768 731
WDR	NE	—	—	NE
WDR for the base year	NE	—	—	NE

^a The Party did not report indirect CO₂ emissions in CRF table 6.

Table 4

Information to be included in the compilation and accounting database for 2014 for the United Kingdom of Great Britain and Northern Ireland
(t CO₂ eq)

	<i>Original submission</i>	<i>Revised estimate</i>	<i>Adjustment</i>	<i>Final</i>
Annex A emissions for 2014	–	–	–	–
CO ₂ ^a	438 874 167	–	–	438 874 167
CH ₄	53 650 070	–	–	53 650 070
N ₂ O	19 446 729	–	–	19 446 729
HFCs	15 980 889	–	–	15 980 889
PFCs	278 315	–	–	278 315
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF ₆	500 316	–	–	500 316
NF ₃	399	–	–	399
Total Annex A sources	528 730 884	–	–	528 730 884
Activities under Article 3, paragraph 3, of the Kyoto Protocol for 2014	–	–	–	–
AR	–1 485 403	–	–	–1 485 403
Deforestation	1 325 054	–	–	1 325 054
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol for 2014	–	–	–	–
FM	–18 660 529	–	–	–18 660 529
CM	12 818 226	–	–	12 818 226
CM for the base year	14 401 097	–	–	14 401 097
GM	–5 603 796	–	–	–5 603 796
GM for the base year	–6 768 731	–	–	–6 768 731
WDR	NE	–	–	NE
WDR for the base year	NE	–	–	NE

^a The Party did not report indirect CO₂ emissions in CRF table 6.

Table 5

Information to be included in the compilation and accounting database for 2013 for the United Kingdom of Great Britain and Northern Ireland
(t CO₂ eq)

	<i>Original submission</i>	<i>Revised estimate</i>	<i>Adjustment</i>	<i>Final</i>
Annex A emissions for 2013	–	–	–	–
CO ₂ ^a	477 751 331	–	–	477 751 331
CH ₄	55 847 741	–	–	55 847 741
N ₂ O	18 900 966	–	–	18 900 966
HFCs	15 786 114	–	–	15 786 114
PFCs	318 734	–	–	318 734
Unspecified mix of HFCs and PFCs	NO, NE	–	–	NO, NE
SF ₆	522 051	–	–	522 051
NF ₃	362	–	–	362
Total Annex A sources	569 127 299	–	–	569 127 299
Activities under Article 3, paragraph 3, of the Kyoto Protocol for 2013	–	–	–	–
AR	–1 208 955	–	–	–1 208 955
Deforestation	1 212 441	–	–	1 212 441
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol for 2013	–	–	–	–

	<i>Original submission</i>	<i>Revised estimate</i>	<i>Adjustment</i>	<i>Final</i>
FM	-19 097 078	—	—	-19 097 078
CM	13 025 567	—	—	13 025 567
CM for the base year	14 401 097	—	—	14 401 097
GM	-5 558 154	—	—	-5 558 154
GM for the base year	-6 768 731	—	—	-6 768 731
WDR	NE	—	—	NE
WDR for the base year	NE	—	—	NE

^a The Party did not report indirect CO₂ emissions in CRF table 6.

Annex III

Additional information to support findings in table 2 in this report

Missing categories that may affect completeness

The categories for which methods are included in the 2006 IPCC Guidelines that were reported as “NE” or for which the ERT otherwise determined that there may be an issue with the completeness of reporting in the Party’s inventory are the following:

- (a) 1.B.2.b.1 shale gas exploration (CO₂ and CH₄) (see ID# E.21 in table 3 in this report);
- (b) 2.A.4.b other uses of soda ash (CO₂) (see ID# I.2 in table 3 in this report);
- (c) 2.A.4.d sodium bicarbonate use (CO₂) (see ID# I.19 in table 5 in this report);
- (d) 2.A.4 ceramic products other than bricks (CO₂) (see ID# I.20 in table 5 in this report);
- (e) 2.E.4 use of perfluorohexane as a heat transfer fluid (PFCs) (see ID# I.28 in table 5 in this report);
- (f) 3.F field burning of agricultural residues for overseas territories (CH₄ and N₂O) (see ID# A.1 in table 3 in this report);
- (g) 3.G liming in Bermuda and Gibraltar (CO₂) (see ID# A.1 in table 3 in this report);
- (h) 3.H urea application in the Falkland Islands (Malvinas), Bermuda and Gibraltar (CO₂) (see ID# A.1 in table 3 in this report);
- (i) 4 the following missing land areas: Bermuda, Cayman Islands, Gibraltar and Montserrat (CO₂) (see ID# L.6 in table 3 in this report);
- (j) 4.A carbon stock change in biomass from forests not used for timber production owing to biomass losses associated with harvesting and/or gathering (see ID# L.14 in table 3 in this report);
- (k) 4.D.1 carbon stock change in organic soils on peat extraction lands remaining peat extraction lands in overseas territories and Crown dependencies (see ID# L.25 in table 3 in this report);
- (l) 4.D.1 flooded land remaining flooded land for overseas territories and Crown dependencies (CO₂, CH₄ and N₂O) (see ID# L.27 in table 3 in this report);
- (m) 4(V) wildfires on forest land and grassland for all overseas territories and Crown dependencies (CO₂, CH₄ and N₂O) (see ID# L.28 in table 3 in this report);
- (n) KP-LULUCF activities for the Cayman Islands and Gibraltar (CO₂, CH₄ and N₂O) (see ID# KL.4 in table 3 in this report);
- (o) Carbon stock changes in litter and deadwood for CM (see ID# KL.9 in table 3 in this report);
- (p) Carbon stock changes for all pools in WDR (see ID# KL.9 in table 3 in this report);
- (q) Carbon stock changes in biomass from forests not used for timber production owing to biomass losses associated with harvesting and/or gathering (see ID# KL.13 in table 3 in this report);
- (r) Controlled burning for the entire year, and on land areas smaller than 1 ha (CO₂, CH₄ and N₂O) (see ID# KL.19 in table 3 in this report).

Annex IV

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

IPCC. 2000. *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. J Penman, D Kruger, I Galbally, et al. (eds.). Hayama, Japan: IPCC/OECD/IEA/Institute for Global Environmental Strategies. Available at <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. S Eggleston, L Buendia, K Miwa, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl>.

IPCC. 2014. *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol*. T Hiraishi, T Krug, K Tanabe, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at <http://www.ipcc-nggip.iges.or.jp/public/kpsg>.

IPCC. 2014. *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*. T Hiraishi, T Krug, K Tanabe, et al. (eds.). Geneva: IPCC. Available at <http://www.ipcc-nggip.iges.or.jp/public/wetlands/>.

B. UNFCCC documents

Annual review reports

Reports on the individual reviews of the 2013, 2014, 2015, 2016 and 2017 annual submissions of the United Kingdom of Great Britain and Northern Ireland, contained in documents FCCC/ARR/2013/GBR, FCCC/ARR/2014/GBR, FCCC/ARR/2015/GBR, FCCC/ARR/2016/GBR and FCCC/ARR/2017/GBR, respectively.

Other

Aggregate information on greenhouse gas emissions by sources and removals by sinks for Parties included in Annex I to the Convention. Note by the secretariat. Available at <https://unfccc.int/sites/default/files/resource/AGI%202019.pdf>.

Annual status report for the United Kingdom of Great Britain and Northern Ireland for 2019. Available at https://unfccc.int/sites/default/files/resource/asr2019_GBR.pdf.

C. Other documents used during the review

Responses to questions during the review were received from Sam Bradley (Department for Business, Energy and Industrial Strategy), including additional material on the methodology and assumptions used. The following references are reproduced as received:

3M™ Novec™ 612 Magnesium Protection Fluid. Product Information Sheet. <https://multimedia.3m.com/mws/media/7139470/3m-novec-612-magnesium-protection-fluid.pdf>.

Baggott SL, et al. (2004) Review of Carbon Emission Factors in the UK Greenhouse Gas Inventory. AEA Energy and Environment, The Gemini Building, Fermi Avenue, Didcot, Oxfordshire, OX11 0QR, UK. November 2004. AEA report number AEAT/ENV/R/2347. Report prepared for UK Defra under contract RMP/2106.

- Bide, T, et al. 2018. United Kingdom Minerals Yearbook 2018. Statistical data to 2017. British Geological Survey Minerals and Waste Programme Open Report OR/19/018. Available at: <https://www.bgs.ac.uk/downloads/browse.cfm?sec=12&cat=132>.
- British Refrigeration Association. 2015. UK Market Statistics 2015. Refrigeration Equipment and Components. Published by Bruce Wright Associates.
- Carrasco, L. et al. (2019). Evaluating Combinations of Temporally Aggregated Sentinel-1, Sentinel-2 and Landsat 8 for Land Cover Mapping with Google Earth Engine. Remote Sensing, vol.11, issue 3. Available at: <https://www.mdpi.com/2072-4292/11/3/288>.
- Center for Ecology and Hydrology. 2008. Countryside survey. CS Technical Report No.4/07 Statistical Report. Available at: <http://eidc.ceh.ac.uk/metadata/59422890-c8d3-49b8-b17e-4f5062475140/cs-technical-report-no.4-07-statistical-report/view>.
- Cooper, A. et al. (2009) Northern Ireland Countryside Survey 2007: Broad Habitat Change 1998-2007. Northern Ireland Environment Agency Research and Development Series No. 09/06. Available at: <https://www.daera-ni.gov.uk/sites/default/files/publications/doe/natural-report-broad-habitat-change-1998-2007.pdf>.
- DEEC. 2016. The United Kingdom's Initial Report under the Second Commitment Period of the Kyoto Protocol. Available at: <https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-kyoto-protocol/second-commitment-period/initial-reports>.
- DEEC. 2014. GHG Inventory Research: Use of EU ETS Data - Iron & Steel Sector, Chemical Industry Feedstock Use. Available at: https://naei.beis.gov.uk/reports/reports?report_id=795.
- DEFRA (Department for Environment, Food and Rural Affairs). 2012. *Capturing cropland and grassland management impacts on soil carbon in the UK Land Use, Land Use Change and Forestry (LULUCF) inventory*. Available at <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18355>.
- Defra (2018). June Agricultural Census, DEFRA. Structure of the agricultural industry in England and the UK at June. Available at: <https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june>.
- Defra AC0114: Synthesis of data. Available on request to the UK. Further details on this project available at: <http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=17179>.
- Defra (2002). Sewage Treatment in the UK. UK Implementation of the EC Urban Waste Water Treatment Directive. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69582/pb6655-uk-sewage-treatment-020424.pdf.
- Department for Business, Energy & Industrial Strategy. 2019. National Forest Accounting Plan of the United Kingdom – Forest Reference Level for the Period 2021-2015. BEIS research paper number 050/1819. 274 pp.
- Environment Agency. 2016. Notice of variation and consolidation with introductory note. The Environmental Permitting (England & Wales) Regulations 2016. Britannia Refined Metals Limited. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/708938/Variation_Notice_BM49451W_V005.pdf.
- Environment Agency. 2016. Notice of variation and consolidation with introductory note. The Environmental Permitting (England & Wales) Regulations 2016. Longs Steel UK Limited. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/488394/Draft_Permit_Variation_EPR_HP3736AW_Long_Products.pdf.

Eunomia Consulting and Research (2011), Inventory Improvement Project – UK Landfill Methane Emissions Model” – Final Report to Defra. Available at: http://randd.defra.gov.uk/Document.aspx?Document=9887_WR1124Finalreportincludingappendices.pdf.

European Environment Agency. Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006. Available at: <https://www.eea.europa.eu/policy-documents/regulation-eu-no-517-2014>.

European Environment Agency. *EMEP/EEA air pollution emission inventory guidebook 2016*. Available at <https://www.eea.europa.eu/publications/emep-eea-guidebook-2016>.

Evans, C. et al. (2017). Implementation of an emission inventory for UK Peatlands. Report to the Department for Business, Energy and Industrial Strategy. Centre for Ecology and Hydrology, Bangor. 88pp.

Golder Associates (2014) for Defra, “Review of landfill methane emissions monitoring,” R Gregory, J Stalleicken, R Lane, S Arnold and D Hall, Report Ref. 13514290381.504/A.1. Available at: http://randd.defra.gov.uk/Document.aspx?Document=12439_WR1908ReviewofMethaneEmissionsModelling.pdf.

Gosden, E. (2012). Gas continues to leak from Total's North Sea well. The Telegraph. Available at: <https://www.telegraph.co.uk/finance/newsbysector/energy/oilandgas/9168227/Gas-continues-to-leak-from-Totals-North-Sea-well.html>.

Henshall, P. (2019) “Reconcile” methodology improvement – implemented for the 1990-2017 GHG inventory. The Research Agency of the Forestry Commission. 19 pp.

IPCC 2011, Use of Models and Facility-Level Data in Greenhouse Gas Inventories (Report of IPCC Expert Meeting on Use of Models and Measurements in Greenhouse Gas Inventories 9-11 August 2010, Sydney, Australia) eds: Eggleston H.S., Srivastava N., Tanabe K., Baasansuren J., Fukuda M., Pub. IGES, Japan 2011.

Levy, P. et al (2017). Estimation of land-use change using a Bayesian data assimilation approach, *Biogeosciences Discuss.*, <https://doi.org/10.5194/bg-2017-466>, in review. Available at https://www.researchgate.net/publication/320885880_Estimation_of_land-use_change_using_a_Bayesian_data_assimilation_approach.

Lopez-Saldana, G. et al. 2017. Applying Earth Observation to assess UK land use change: Lot 1 – Coarse Resolution Optical. Draft final report prepared for BEIS.

Matthews, R. et al. (2017). The CARBINE model, a technical description (version 11). The Research Agency of the Forestry Commission.

Matthews R. et al (2018). SCOTIA forest carbon soil model: interim progress report on comparison of model estimates and measurements of soil carbon stocks and fluxes. The research Agency of the Forestry Commission.

Milbrath, D. 2004. 3M™ Novec™ 612 Magnesium Protection Fluid. Presentation to the International Conference of SF₆ and the Environment. Available at: https://www.epa.gov/sites/production/files/2016-02/documents/conf04_milbrath.pdf.

Mitchard, E. et al. (2016). Applying Earth Observation to assess UK land use change. Tender Reference Number 1235/11/2016. University of Edinburgh, School of GeoSciences.

Moxley, J. et al (2014). Capturing the effect of cropland and grassland management on biomass carbon stocks in the UK LULUCF Inventory. 51 pp.

Natural Resources Wales. (2010). Permit with Introductory Note: The Environmental Permitting (England & Wales) Regulations. Available at: <https://naturalresources.wales/media/676099/20160208-eprbl7108imv015-tata-port-talbot-permit-signed.pdf>.

Netcen (2004), “Non-Road Mobile Machinery Usage, Life and Correction Factors”, Report to the Department for Transport, AEAT/ENV/R/1895, November 2004, www.airquality.co.uk/archive/reports/reports.php?report_id=304.

Rawlins et al. (2011). The importance of inorganic carbon in soil carbon databases and stock estimates: a case study from England. *Soil Use and Management*. Available at: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1475-2743.2011.00348.x?casa_token=SDvcHvQWnfkAAAAA%3A9OdaFB7iFNUIea2VJrsqqcC8qlk8-jVoxY38rk7oyWx1lnCl7elTVlq988gl-P_5jjsNc-xRxFi1Axt.

REGULATION (EU) No 517/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006.

Resource Futures (2012). Biodegradability of municipal solid waste (WR1003). Available at: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwi1juuw3qLIAhWG16QKHS5nCd4QFjABegQIAhAI&url=http%3A%2F%2Frandd.defra.gov.uk%2FDocument.aspx%3FDocument%3D12266_WR1003BiodegradabilityofMSWReporrtfinal.pdf&usq=AOvVaw2Qt2ay8YTNC03MJqkn_yhj.

Ricardo (2016). GHG Inventory F-gas Improvements 2015. Report for the Department of Energy and Climate Change.

Rowland, C. et al. 2017. Applying Earth Observation to Assess UK Land Use Change: LOT 2 Medium Resolution Optical. Center for Ecology & Hydrology. Draft final report prepared for BEIS.

Schwarz, W. and B. Gschrey (2009). Service contract to assess the feasibility of options to reduce emissions of SF₆ from the EU non-ferrous metal industry and analyse their potential impacts. Prepared for the European Commission. Available at: https://pdfs.semanticscholar.org/f177/cdbd494b8d0f28e933ec605d5dac0b0fd54f.pdf?_ga=2.213362332.9688148.1571303862-980415723.1571303862.

Smart, et al. (2009). Chapter 8. The National Picture. From the Countryside Survey. Available at: <https://countrysidesurvey.org.uk/sites/default/files/CS-Wales-Results2007-Chapter08.pdf>.

Tomlinson et al (2018). Quantifying gross vs. net agricultural land use change in Great Britain using the Integrated Administration and Control System. *Science of the Total Environment* 628–629. pp.1234–1248. Available at: <https://www.sciencedirect.com/science/article/pii/S0048969718304558>.

Wood, C. et al. (2017). Long-term vegetation monitoring in Great Britain – the Countryside Survey 1978–2007 and beyond. Available at: <https://www.earth-syst-sci-data.net/9/445/2017/essd-9-445-2017.pdf>.